

Taxonomic review of Diplommatinidae (Caenogastropoda: Cyclophoroidea) from Wallacea and the Papuan Region

KRISTINE GREKE

Dārza iela 10, LV-2130, Dzidriņas, Stopiņu novads, Latvia; e-mail: k.greke@gmail.com

Abstract: Diplommatinidae L. Pfeiffer, 1856 from the Papuan Region and Wallacea excluding the island of Sulawesi are revised taxonomically. A total of 121 species in 5 genera are recognized within the study area. Type material of all previously described species from New Guinea, Wallacea and Solomon Islands was examined. Fifteen lectotypes are designated and four species are synonymized. The genus *Anostomella* Martens, 1867 is synonymized with *Palaina* O. Semper, 1865 based on DNA sequence data and shell conchological characters. Six new combinations are proposed based on both conchological characters and DNA sequence data. 54 new species are described, illustrated and keyed. The distribution of each species is mapped allowing biogeographic analyses. Chirality of Papuan and Wallacean Diplommatinidae is discussed. The conservation status of each species is preliminary assessed with regard to IUCN guidelines.

Key words: Gastropoda, Diplommatinidae, Papuan Region, Wallacea, Lesser Sunda Islands, Solomon Islands Moluccas, New Guinea, taxonomy, biogeography, nomenclatural changes, endemism, conservation, identification, chirality, phylogeny.

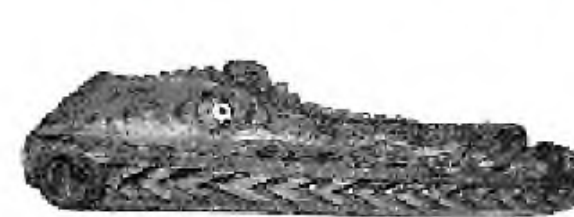
Introduction

The Diplommatinidae L. Pfeiffer, 1856 are minute (1-10 mm) terrestrial caenogastropod snails distributed in subtropical and tropical Asia from eastern Russia and Japan in the north to Sri Lanka and the Sunda Islands in the south, as well as northeastern Australia, the Papuan Region, and Pacific islands, with a single genus *Adelopoma* Doring, 1884 in Central and South America (Egorov 2013). Earlier authors established numerous genera based only on conchological characters. The variation within genera and subgenera established by earlier authors is very high and characters used for distinction of (sub)genera are often of low taxonomic value (e.g. variable characters of shell ribbing pattern, shell shape etc.). Taking into account the diversity of shell forms in diplommatinids, many of these (sub)generic taxa are considered dubious (e.g. Vermeulen 1993, 1996a). The Diplommatinidae are widely known for high endemism and small geographically narrow ranges, which are often restricted to small limestone areas (e.g. Clements et al. 2006; Liew et al. 2014; Vermeulen 1996a).

The Papuan Region is a vast equatorial insular system of complex geological history situated between the Asian, Australian and Pacific plates. It is

a region with diverse and highly endemic fauna. Despite recent significant progress in diplommatinid research in SE Asia and the Pacific (e.g. Vermeulen 1991, 1993, 1996a; Neubert & Bouchet 2015; Yamazaki et al. 2015a, 2015b), almost no new information has been published on species in the Papuan Region since the last review of the West Papuan terrestrial operculates by van Benthem Jutting (1963) which was based on limited material available at that time. Even less attention was paid to the diplommatinids of Lesser Sunda Islands (= Nusa Tenggara), the Moluccan and the Solomon Islands.

Recent collecting by various scientific institutions in New Guinea, the Solomon Islands, the Moluccas and Lesser Sunda Islands provides material for the first comprehensive revision of the Diplommatinidae from the Papuan Region (Sulawesi is excluded from present study since no new material was available from this island). 71 Diplommatinidae species (some are synonymized in the present work) from the genera *Arinia* H. et A. Adams, 1856, *Diancta* s. str. Martens, 1864, *Diplommatina* s. l. Benson, 1849, *Moussonina* s. str. O. Semper, 1865, *Palaina* s. l. O. Semper, 1865, and *Pseudopalaina* von Möllendorff, 1897 were previously reported from the study area. Another 54 species are de-



scribed, illustrated and keyed in the present work. This study proposes six new combinations. Five new synonyms are proposed. The genus *Anostomella* Martens, 1867 is synonymized with *Palaina* O. Semper, 1865. The species *Palaina delli* Clench, 1965 is synonymized with *P. (s. l.) gardneri* Dell, 1955; *P. megamorpha* Solem, 1960 is synonymized with *Palaina (s. l.) aerari* (Dell, 1955); *P. vexator* I. et B. Rensch, 1929 is synonymized with *P. (s. l.) novopommerana* I. et B. Rensch, 1929; the subspecies *P. commixta jacquinoti* I. Rensch, 1937 is synonymized with *P. (s. l.) commixta* I. Rensch, 1937. Lectotypes are designated for the following 15 species: *Arinia (s. l.) blanda* E.A. Smith, 1897, *A. (s. l.) talautana* Fulton, 1898, *Diancta (s. str.) constricta* (Martens, 1864), *D. (s. str.) torta* O. Boettger, 1891, *Diplommatina (s. l.) floresiana* E.A. Smith, 1897, *D. (s. l.) smithi* Kobelt et von Möllendorff, 1898, *D. (s. l.) symmetrica* Hedley, 1891, *Moussonia athena* (Preston, 1913), *Palaina (s. l.) ascendens* (Martens, 1864), *P. (s. str.) diepenheimi* (Preston, 1913), *P. (s. l.) dohertyi* E.A. Smith, 1897, *P. (s. l.) granulum* I. et B. Rensch, 1929, *P. (s. l.) novoguineensis* E.A. Smith, 1897, and *P. (s. l.) schneideri* I. et B. Rensch, 1929. The following 54 new taxa are described and illustrated: *Diancta (s. str.) halmaherica* sp. nov. (Halmahera Is.), *D. (s. str.) obiensis* sp. nov. (Obi Islands), *Diplommatina (s. l.) jonabletti* sp. nov. (Flores Is.), *D. (s. l.) maibrat* sp. nov. (W New Guinea), *D. (s. l.) moluccensis* sp. nov. (Ternate & Tidore islands), *D. (s. l.) patani* sp. nov. (Halmahera Is.), *D. (s. l.) slapcinskyi* sp. nov. (Obi Islands), *D. (s. l.) telnovi* sp. nov. (W New Guinea & Misool Is.), *D. (s. l.) timorensis* sp. nov. (Timor Is.), *D. (s. l.) waigeoensis* sp. nov. (Waigeo Is.), *Moussonia echinata* sp. nov. (W New Guinea), *M. manuse-lae* sp. nov. (Seram Is.), *M. monstificabilis* sp. nov. (Misool Is.), *M. pseudoseparanda* sp. nov. (W New Guinea), *M. separanda* sp. nov. (Misool Is.), *M. torricelli* sp. nov. (N New Guinea), *Palaina (s. l.) albrechti* sp. nov. (N New Guinea), *P. (s. l.) attenboroughi* sp. nov. (Misool Is.), *P. (s. l.) bougainvillei* sp. nov. (Bougainville Is. group), *P. (s. l.) dianctoides* sp. nov. (W New Guinea), *P. (s. l.) doberai* sp. nov. (W New Guinea), *P. (s. l.) extremita* sp. nov. (E New Guinea), *P. (s. l.) flavocylindrica* sp. nov. (W New Guinea), *P. (s. l.) hartmanni* sp. nov. (Waigeo Is.), *P. (s. l.) iha* sp. nov. (W New Guinea), *P. (s. l.) imperfecta* sp. nov. (Waigeo Is.), *P. (s. l.) insulana* sp. nov. (Polee Is. near Misool), *P. (s. l.) laszloi* sp. nov. (Wayag Is. near Waigeo Is.), *P. (s. l.) lengguru* sp. nov. (W New Guinea), *P. (s. l.) lousiade* sp. nov. (Lousiade Islands), *P. (s. l.) mairasi* sp. nov. (W New Guinea), *P. (s. l.) megalostoma* sp. nov. (Waigeo Is.), *P. (s. l.) mengen*

sp. nov. (New Britain Is.), *P. (s. l.) minuscularia* sp. nov. (Misool Is.), *P. (s. l.) minutula* sp. nov. (Halmahera Is.), *P. (s. l.) mirifica* sp. nov. (Yamdena Is.), *P. (s. l.) misoolensis* sp. nov. (Misool Is.), *P. (s. l.) mutis* sp. nov. (Timor Is.), *P. (s. l.) obiensis* sp. nov. (Obi Islands), *P. (s. l.) onin* sp. nov. (W New Guinea), *P. (s. l.) papuamontis* sp. nov. (Central New Guinea), *P. (s. l.) paradisaea* sp. nov. (Waigeo Is.), *P. (s. l.) perspectiva* sp. nov. (W New Guinea), *P. (s. l.) psittricha* sp. nov. (Misool Is.), *P. (s. l.) silvicultrix* sp. nov. (Waigeo Is.), *P. (s. l.) slapcinskyi* sp. nov. (N New Guinea), *P. (s. l.) sparselamellata* sp. nov. (Waigeo Is.), *P. (s. l.) tanimbarensis* sp. nov. (Yamdena Is.), *P. (s. l.) telnovi* sp. nov. (Waigeo Is.), *P. (s. l.) thomasrinteleni* sp. nov. (Yamdena Is.), *P. (s. l.) vermeuleni* sp. nov. (Aru Islands), *P. (s. l.) waigeo* sp. nov. (Waigeo & Wayag islands), *P. (s. l.) wawiyai* sp. nov. (Waigeo Is.), and *P. (s. l.) yamdena* sp. nov. (Yamdena Is.). An identification key to the Diplommatinidae of the Papuan Region and Wallacea is compiled for the first time. Taxonomic decisions based on morphological data are corroborated by new DNA sequence data studied for certain taxa. Biogeographically, all genera are shared with neighbour regions of insular Asia and Australia. Only 2 species are shared with adjacent regions. Therefore, >98% of diplommatinid species from Wallacea and the Papuan Region considered regional and local endemics with very restricted distribution.

Papuan and Wallacean Diplommatinidae are usually associated with limestone areas and are especially diverse in regions with limestone soils (for example, Raja Ampat islands of Misool and Waigeo, Cenderawasih Bay Island of Biak etc.). Most Papuan diplommatinids are reported from primary or old growth secondary rainforests but several species are also recorded from secondary rainforest areas and even from gardens and plantations suggesting some species are ecologically plastic. Conservation status was assessed using IUCN methodology (for details see chapter “Materials and Methods”) for all species. Most species are classified as Data Deficient and Least Concern.

Considering the large study area, about 1% of the Earth's total land area, a complex geological history, numerous islands, rich fauna, dramatic and inaccessible terrain and high cost of biological studies in this part of the world, this revision to be considered preliminary investment into the knowledge of the Papuan and Wallacean diplommatinids. No malacological studies performed at all or no diplommatinid material is available from many islands (e.g. Kei Islands, Manus Island, New Ireland, Sula Islands etc.) or parts of larger islands



(e.g. Central Cordillera of Indonesian New Guinea, Adelbert Range, lowlands of Bomberai Peninsula etc.). Our knowledge of the fauna of other islands (e.g. Bougainville, Seram, Timor, and New Guinea) is still fragmentary. The 121 species now known from the Papuan Region and Wallacea (Sulawesi excluded) probably represent only a fraction of the total diplommatinid diversity for the area, especially when compared to the 42 species reported from Fiji (Neubert & Bouchet 2015) and the nearly 170 diplommatinid taxa found on Borneo (Liew 2016).

Materials and methods

The present review is the first attempt to summarize existing knowledge of the Diplommatinidae of Wallacea and Papuan Region, and presents new information based on additional material available from recent surveys and museum collections.

The material

Diplommatinids were collected from leaf litter using standard techniques including Winkler and other sieves or by hand from the underside of stones and fallen leaves, or inside or under rotten wood. Rocky formations, especially those composed of limestone were inspected visually for rupicole species. Totally over 500 specimens were studied. Among them about 30% are previously identified museum material including type material and about 70% are recently collected specimens. This review reflects the current knowledge of diplommatinid snails within the study area and is limited, because available material is sparse and much of the Papuan and Wallacean region remains to be sampled. The diversity of Diplommatinidae in Wallacea and Papuan Region is predicted to be much higher than the results of this first study.

Most specimens described below (with the exception of historical ones) are preserved in 99% ethanol. Specimens were studied using a Leica S6D stereomicroscope. The internal lamellar system was exposed using pins (size 1 or 3 depending on the dimensions of the shell). Specimens were photographed using a Canon EOS 450D DSLR camera attached to a stereomicroscope. Multiple photographs were taken at different focal planes and reassembled using CombineZP software. Scanning electron microscope (SEM) photographs were taken using SEM provided by the Latvian University's Faculty of Biology. Shells were ultrasonically cleaned in distilled water for 5 min, washed through a grad-

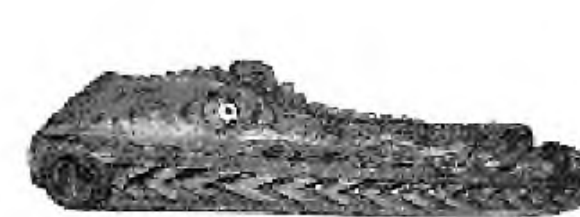
ed alcohol series up to 99%, air dried and placed dorsally onto conductive tape on aluminium stubs. Shells were imaged using a Hitachi TM-3000 (Hitachi High Technologies ®) SEM following methods described by Geiger et al. (2007).

Holotypes of the newly described species are deposited in the collections of Natural History Museum in London (United Kingdom), Natural History Museum in Erfurt (Germany), Naturalis Biodiversity Center in Leiden (The Netherlands), Florida Museum of Natural History in Gainesville (U.S.A.), and Lee Kong Chian Natural History Museum in Singapore.

All genera and species are listed alphabetically, because a phylogenetic arrangement is currently impossible. All label text is reproduced without corrections or additions; labels (if more than one for the same specimen) are separated by slashes (/). All labels are printed unless stated otherwise. Author's comments are placed in square brackets []. All type specimens of new species described in the present publication are provided with an additional black-framed printed label 'Holotypus' or 'Paratypus' on red paper. Consequently, lecto- and paralectotype specimens designated below are provided with additional labels 'Lectotypus' or 'Paralectotypus'.

Acronyms for scientific collections used in the text:

- BMNH – British Museum (Natural History), London, United Kingdom;
- FMNH – The Field Museum of Natural History, Chicago, U.S.A.;
- KGC – Collection Kristine Greke, Dzidriņas, Latvia;
- LKCNHM – Lee Kong Chian Natural History Museum, National University of Singapore, Singapore;
- MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, U.S.A.;
- MHUB – Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany;
- MMUE – The University of Manchester Museum, Manchester, United Kingdom;
- MONZ – Museum of New Zealand, Wellington, New Zealand;
- MSNG – Museo Civico di Storia naturale „Giacomo Doria“, Genova, Italy;
- NHMB – Naturhistorisches Museum Basel, Switzerland;
- NME – Naturkundemuseum Erfurt, Germany;
- NMNL – National Museum of Natural History „Naturalis“, Leiden, The Netherlands;
- SMF – Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany;
- SNSD – Senckenberg Naturhistorische Sammlungen, Dresden, Germany;
- UF – Florida Museum of Natural History, University of



Florida, Gainesville, U.S.A.;
 UMMZ – Museum of Zoology, University of Michigan, Ann Arbor, U.S.A.;
 UWCP – Museum of Zoology, University of Wrocław, Poland.
 ZSM – Zoologische Staatssammlung München, Germany.

Phylogenetic assessment

For phylogenetic reconstruction, the following methodology was used: Gene fragment: mitochondrial cytochrome c oxidase subunit I (COI), primer combinations (forward / reverse) used for the amplification = LC01490 / COR722b (Folmer et al. 1994; Wilke & Davis 2000, respectively) and L1490-Alb / H2198-Alb (Gittenberger et al. 2004). Number of taxa = 94 (12 newly sequenced Diplommatinidae taxa from Wallacea and New Guinea plus 78 taxa downloaded from GenBank: 36 from Rundell 2008, 42 from Webster et al. 2012, and 4 outgroup taxa).

Used outgroup based on the phylogeny of Webster et al. (2012) = *Aperostoma palmeri* (DQ093523), *Conus miles* Linnaeus, 1758 (AY588202), *Conus miliaris* Hwass in Bruguière, 1792 (FJ411486), and *Pomacea insularum* (D'Orbigny, 1839) (FJ946828). Fragment length = 658 base pairs (bp). Used model of sequence evolution = GTR + I + Γ (selected by the software jModelTest version 2.1.4 based on the Akaike Information Criterion). Phylogenetic relationships were reconstructed using Bayesian inference implemented in the software package MrBayes version 3.2.2: used parameter: nchains = 4, ngen = 5 000 000, samplefreq = 100, temp = 0.1, burnin = 25% (N = 12 500). For DNA extraction and PCR reaction, same conditions were followed as a previous study (Webster et al. 2012).

Conservation status assessments and endemism

Conservation status is assessed for each species using IUCN Red list criteria and guidelines (IUCN 2016). Conservation status is assessed using data from fieldwork in the Papuan Region in 2007-2016 as well as published information and museums specimens. When applicable, GeoCat tool (Bachman et al. 2011) was used to calculate extent of occurrence and area of occupancy. These IUCN assessments to be considered preliminary since they were not controlled and approved by IUCN staff.

Categories of endemism used in the text (see chapter “Annotated list of the Diplommatinidae from the Papuan Region and Wallacea” below) are based on Hamer & Slotow (2002).

Terminology used in this review

Consider Map 1 for study area boundary definition. Lesser Sunda Islands, or Nusa Tenggara is the geographic term for a group of mainly Indonesian islands of the Sunda volcanic arc that are situated to the east of Java Island. The main islands and their groups (west to east) are: Bali, Lombok, Sumbawa, Flores, Sumba, Timor, Alor Archipelago, Tanimbar Islands. All of these islands except Bali are considered part of Wallacea.

Wallacea – zoogeographic term used in the broad sense for a group of mainly Indonesian islands located in between Wallace’s Line in the West and Lydekker’s Line in the East, e.g. Lesser Sunda Islands (Map 1), the Moluccas and Sulawesi. Eastern part of Wallacea (The Moluccas incl. Kei and Tanimbar Islands) is a part of the Papuan Region. Sulawesi is not included into my study area.

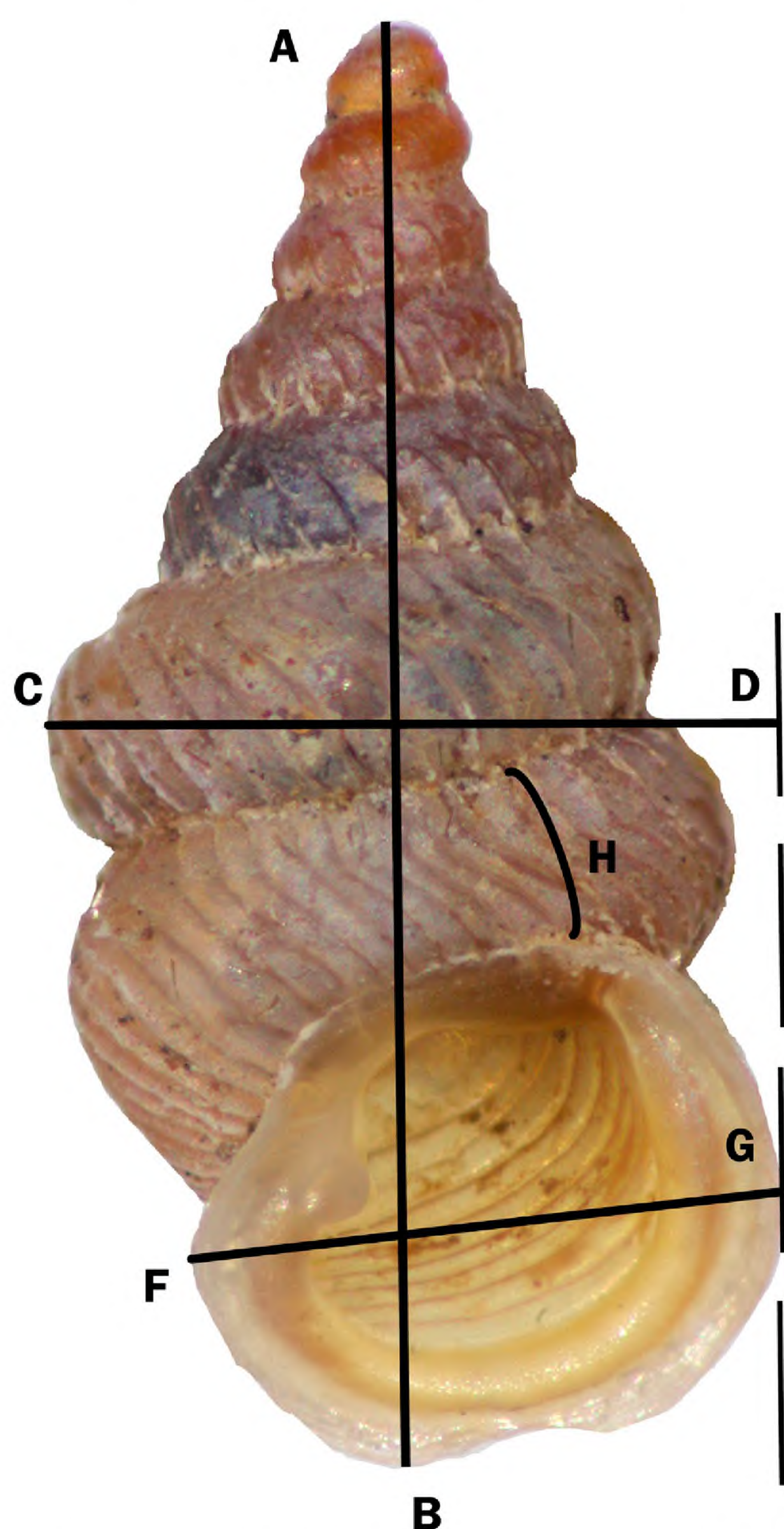


Figure 1. Terminology for measurements. A-B – shell height (H); A1-B1 – height of last whorl (HW); C-D – shell width (D); F-G – maximum width of peristome (PD); H – beginning of the ultimate whorl.



Papuan Region – zoogeographic term in the sense of Gressitt (1982), Beehler et al. (1986), Riedel (2002), and Telnov (2011). This area is defined as the Sahul continental shelf islands, including those north and east of New Guinea and Torres Strait islands south of it. In the west, chains of Moluccan Islands (North, Central and South Moluccas) with a high percentage of Papuan faunal elements, are also considered part of the Papuan Region with Weber's Line used as the western boundary of the region. In parallel, these islands are also a part of Wallacea (Map 1).

For all species, the following measurements were taken: shell height (Fig. 1. A-B) in most species supplemented with height of the last whorl (Fig. 1 A1-B1), shell width (Fig. 1 C-D), maximum width of the peristome inclusive of its maximum expansions (Fig. 1 F-G). Species were split into four informative groups by their shell size:

very small – average shell height does not exceed 2 mm;

small – average shell height is between 2-3 mm;

large – average shell height is between 3-5 mm;

very large – average shell height exceeds 5 mm.

Density of axial ribs was measured on penultimate whorl on the apertural side of the shell.

The internal lamellae of diplommatinid shells are usually rich in characters and can be extremely useful for taxonomic purposes (Fig. 2). With a few modifications I follow the terminology introduced by Liew et al. (2014) and supplemented by Neubert &

Bouchet (2015) as follows:

columellaris (c) – a lamella on the columella that extends into the interior of the shell; it may be visible in the aperture as a basal denticle, it can be smooth or can undulate or bear secondary denticles;

columellar plate (clp) – a basal broadening of the columella in the last whorl; it may be subdivided into two sections, outer plate (pointing towards the aperture), and the internal plate (pointing towards the shell's interior);

palatal structures (I use the term “internal lamellae” for them) – there can be one to several lamellae (or small denticles in non-Papuan taxa), which may be spirally or axially oriented; in constricted species these structures tend to be shifted to the base of the penultimate whorl.

Additional external conchological characters used are:

bulb – a lateral voluminous protrusion of the ultimate whorl;

constriction – a narrowing of the whorl, and the furthest point that the snail can retract the shell and therefore the point where the operculum rests. There are calcareous structures – lamellae or teeth around or inside the aperture that constrict the shell opening. The constriction is often defined by an impression on the shell wall and at the suture, in addition to a change in ribbing pattern and sculpture;

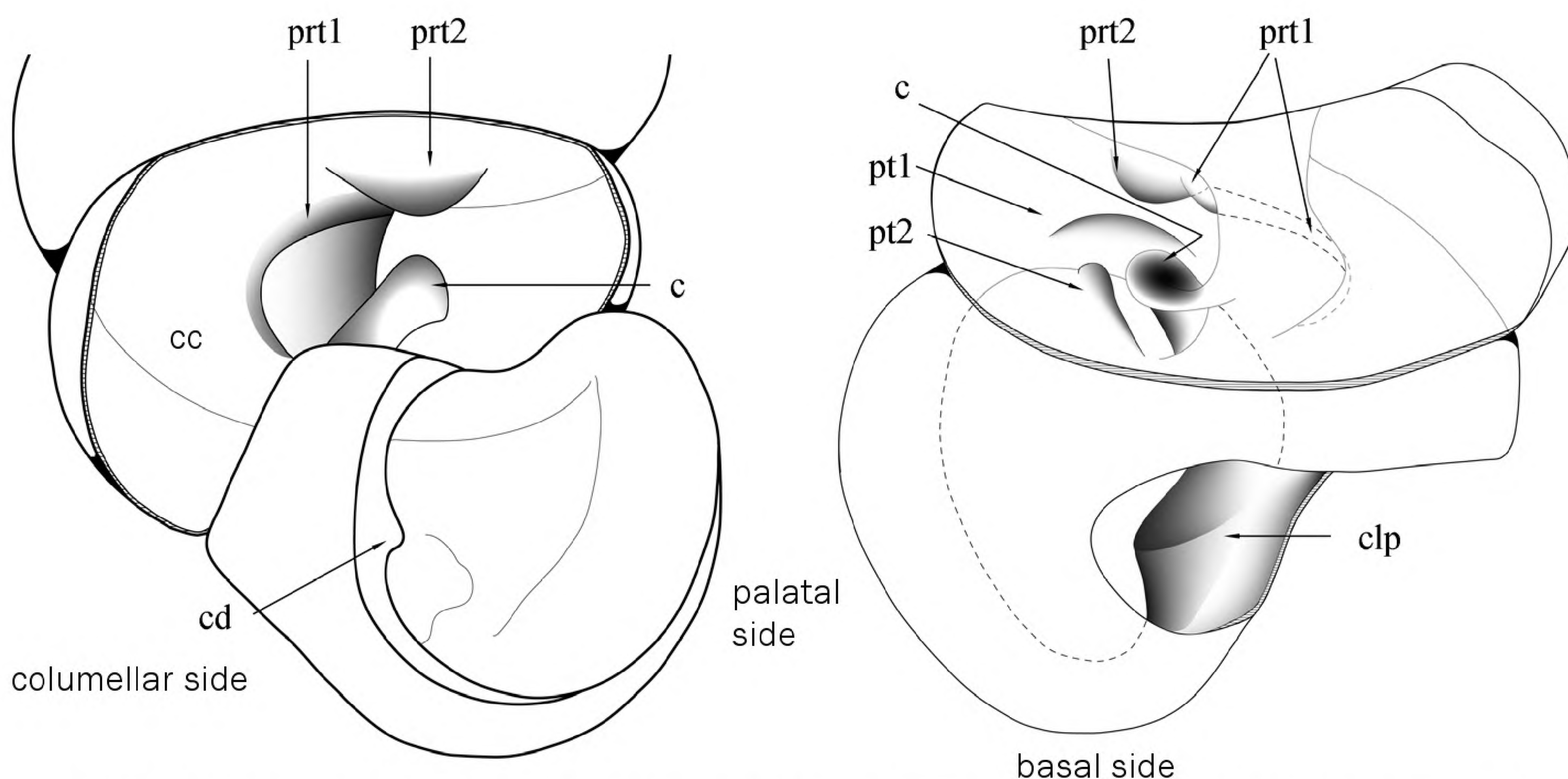
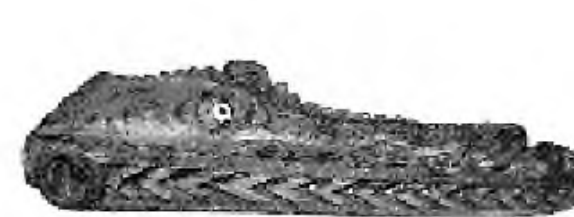


Figure 2. Terminology of the lamellae apparatus of the Diplommatinidae (after Neubert & Bouchet, 2015, with modifications).



aperture and peristome – the following terms are used for apertural characters: palatal side (outer side at shell margin), columellar side (inner side along columella), parietal side (= upper side against penultimate whorl), basal side (= lower). The diplommatinid shell has either a simple or a double, rarely triple peristome, and this pattern is often species specific;

spiral striae – spiral sculpture on the teleoconch composed of raised microscopic spiral ridges. The intensity of the spiral lines depends on the size of these micro-structures (Figs 108-145);

microscopic pits – mostly randomly arranged pit-like sculpture of the protoconch composed of more or less dense pits (punctures) on the embryonic whorls (Figs 3-4);

axial ribs – axial ridges caused by a change of shell ontogeny in both shell accretion direction and aperture dimensions. During rib formation,

the shell material accretion direction around the aperture changes from longitudinal to orthogonal, aperture size increases and aperture shape possibly changes also. Ribs can be simple, sinuous or humped, coarse or delicate, low or high (lamella-like);

tuba – the ultimate whorl beyond the constriction.

Abbreviations used in the Figs 1-2 and in the text (list of museum acronyms is given above):

AOO – area of occupancy (see IUCN 2016 for the definition);

EOO – extent of occurrence (see IUCN 2016 for the definition);

env. – environs;

PNG – Papua New Guinea (country);

vill. – village or little settlement;

c – columellaris (consider Fig. 2);

cc – columellar corner;

cd – columellar denticle (consider Fig. 2);

clp – columellar plate;

H – shell height including the peristome (consider Fig. 1);

HW – height of ultimate whorl (consider Fig. 1);

juv. – juvenile (not adult or subadult) specimen;

mt. – mount;

PD – maximum width of peristome (consider Fig. 1);

prt1 – inner parietalis (consider Fig. 2);

prt2 – outer parietalis (consider Fig. 2);

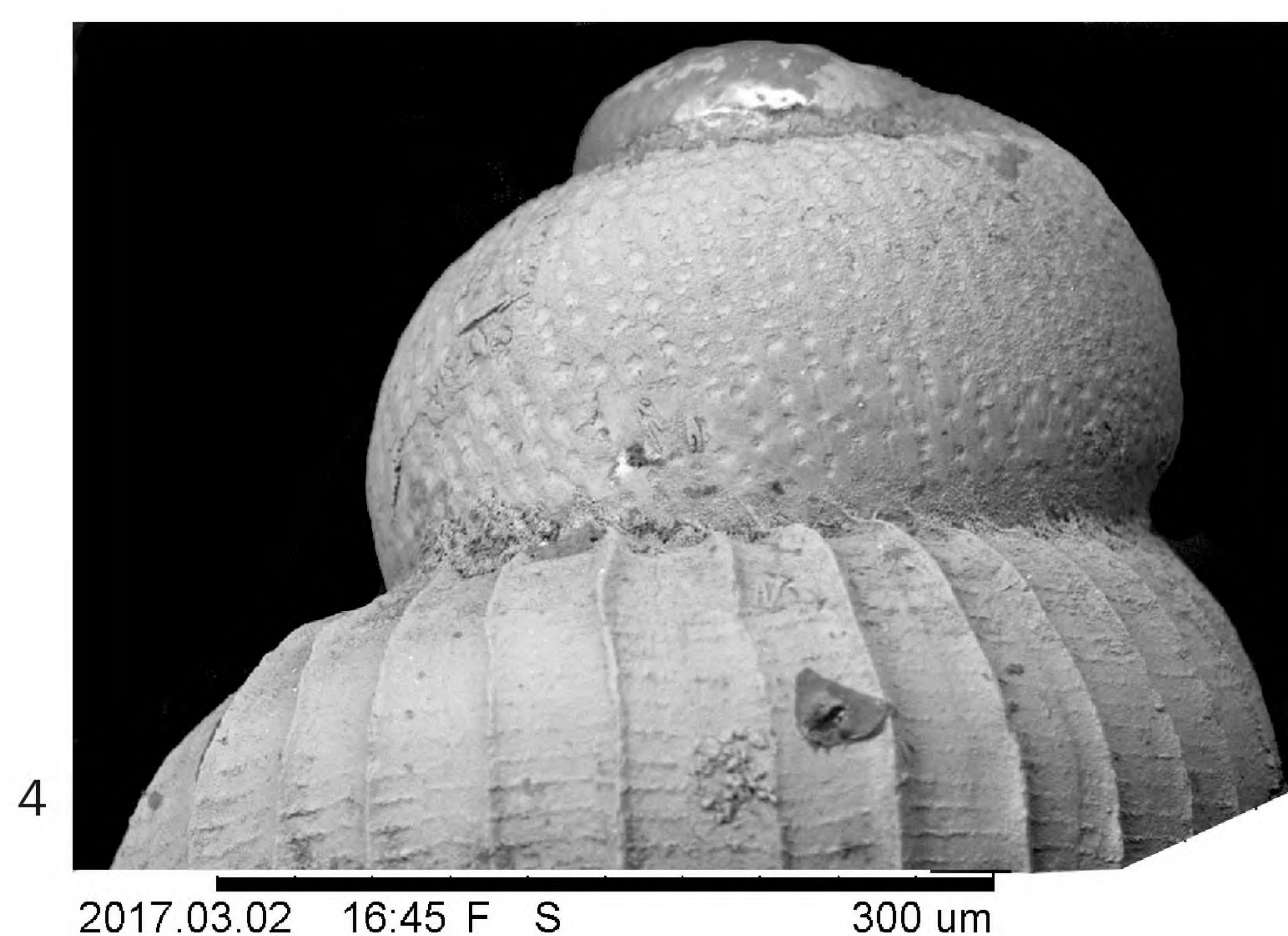
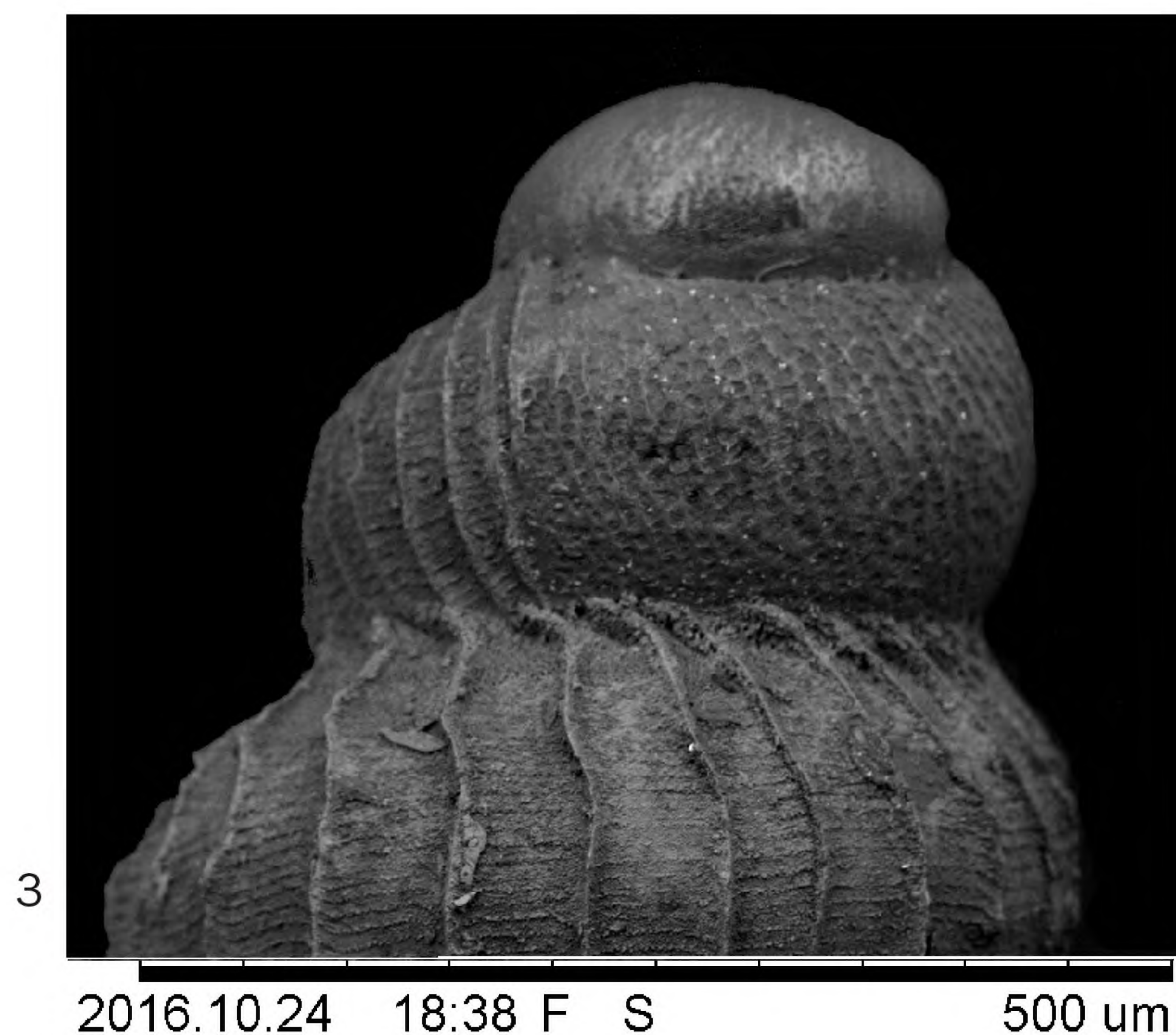
pt – palatalis;

pt1 – parallel palatalis (consider Fig. 2);

pt2 – perpendicular palatalis (consider Fig. 2);

µm – micrometre;

W – number of whorls inclusive embryonic ones (if shell is not decollate).



Figures 3-4. Embryonic whorls and the first teleoconch whorl of *Diplommantina radiiformis* Preston, 1913 at 200x (Fig. 3) and 300x (Fig. 4) magnification, showing microstructures of the shell.

The area

The study area (Map 1) extends about 4 800 km from Lombok on the West to the easternmost Solomon Islands on the East. The study area includes the following insular systems and large islands: the classic Wallacea (the Moluccas, Lesser Sunda Islands, Timor, Tanimbar Islands, Banda Islands and Kei Islands), and the Papuan Region (New Guinea with satellite islands (Aru Islands, Cenderawasih Bay islands of Biak, Supiori, Numfoor and Yapen), Raja Ampat Islands (e.g. Batanta, Misool, Salawati and Waigeo), Bismarck and Admiralty archipelagos, as well as Louisiade Islands and D'Entrecasteaux Islands), and the Solomon Islands). Sulawesi, which is considered a part of the Wallacea, was intentionally excluded since no unstudied recent material from this island was avail-



able for the present study. Despite being a part of the Lesser Sunda Island chain, zoogeographically Bali is not a part of Wallacea and it is not included in the present study.

Despite presence of well-described significant differences in climate, geology and ecology between Lesser Sunda Islands and the Moluccas, New Guinea and the Solomon Islands, my review is not split into parts. Papuan taxa are assessed together with those from Lesser Sunda Islands.

Taxonomy

Egorov (2013) listed all known genera and subgenera of recent diplommatinid snails based on data published by earlier authors. Despite several recent studies from adjacent regions parts of the Pacific, Indo-Australian islands and Australia (Vermeulen 1991, 1993, 1996a; Clements et al. 2008; Vermeulen & Clements 2008; Stanisic et al. 2010; Webster et al. 2012; Neubert & Bouchet 2015; Yamazaki et al. 2013; Yamazaki K. et al. 2015a; Yamazaki M. et al. 2015b), modern concepts of most genera of Diplommatinidae are still lacking.

Diplommatinid (sub)genera are rather poorly defined and most conchological characters used for defining genera and subgenera by earlier authors are highly variable and may not be useful in

defining generic level groupings similar to Fijian Diplommatinidae (Neubert & Bouchet 2015). A first attempt at a phylogeny of diplommatinid species was made recently (Webster et al. 2012), but no representatives from Wallacea or the Papuan Region was included.

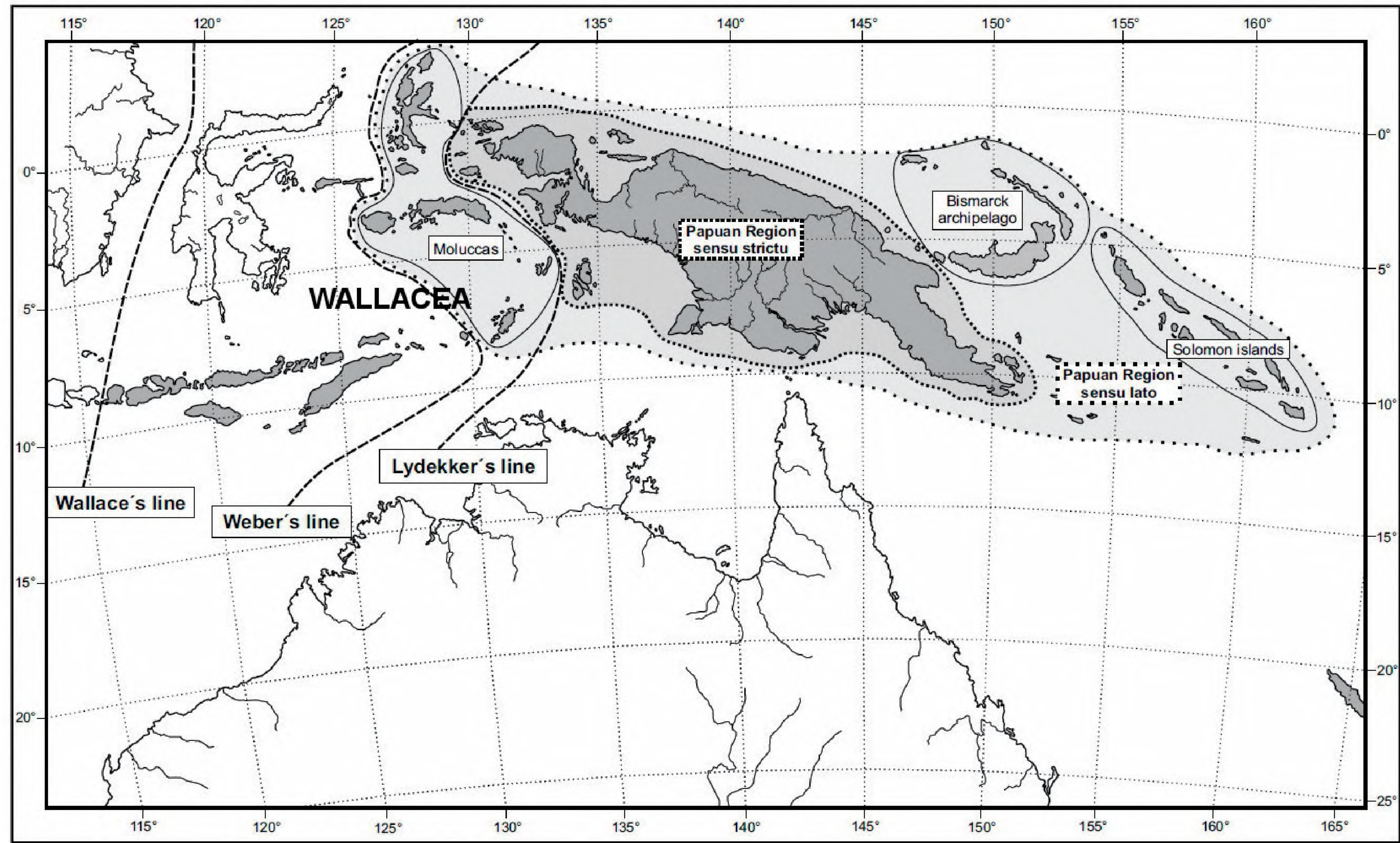
Vermeulen (1993) and Stanisic et al. (2010) used the genus name *Diplommatina* Benson, 1849 in a very broad sense for a large number of species sharing various shell characters, but Yamazaki et al. (2013) advised against such a broad definition of *Diplommatina* (Neubert & Bouchet 2015).

As shown by Webster et al. (2012) and later by Neubert & Bouchet (2015), Diplommatinid genera tend to be constrained to discrete geographical areas.

History of Diplommatinidae exploration in Wallacea and Papuan Region

My review of historical aspects of diplommatinid snail studies is based on a comprehensive assessment of literature on non-marine molluscs of the Papuan Region (Greke & Telnov 2014). There is no similar assessment or checklist for the Lesser Sunda Islands and historical review for this area was performed in parallel with taxonomic work.

The fauna of the Papuan and Wallacean re-



Map 1. The study area - Wallacea and Papuan region, showing important zoogeographic lines. Study area is shaded in dark grey (redrawn from The Times Atlas of the World (1994), with modifications by Riedel (2002) and by the author).



gions is known from approximately 30 mostly short papers. The first description of a diplommatinid from the area contained two species (Martens 1864). Until 1955, authors described new taxa based on material collected mainly from the Moluccas, easily accessible coastal areas and offshore islands of

New Guinea, and from the Solomon Islands (Fig. 5). The most important contributions to the knowledge of the area were made by Rensch (1931) and van Benthem Jutting (1958a) for Lesser Sunda Islands, and van Benthem Jutting (1958b, 1963) for the Papuan Region.

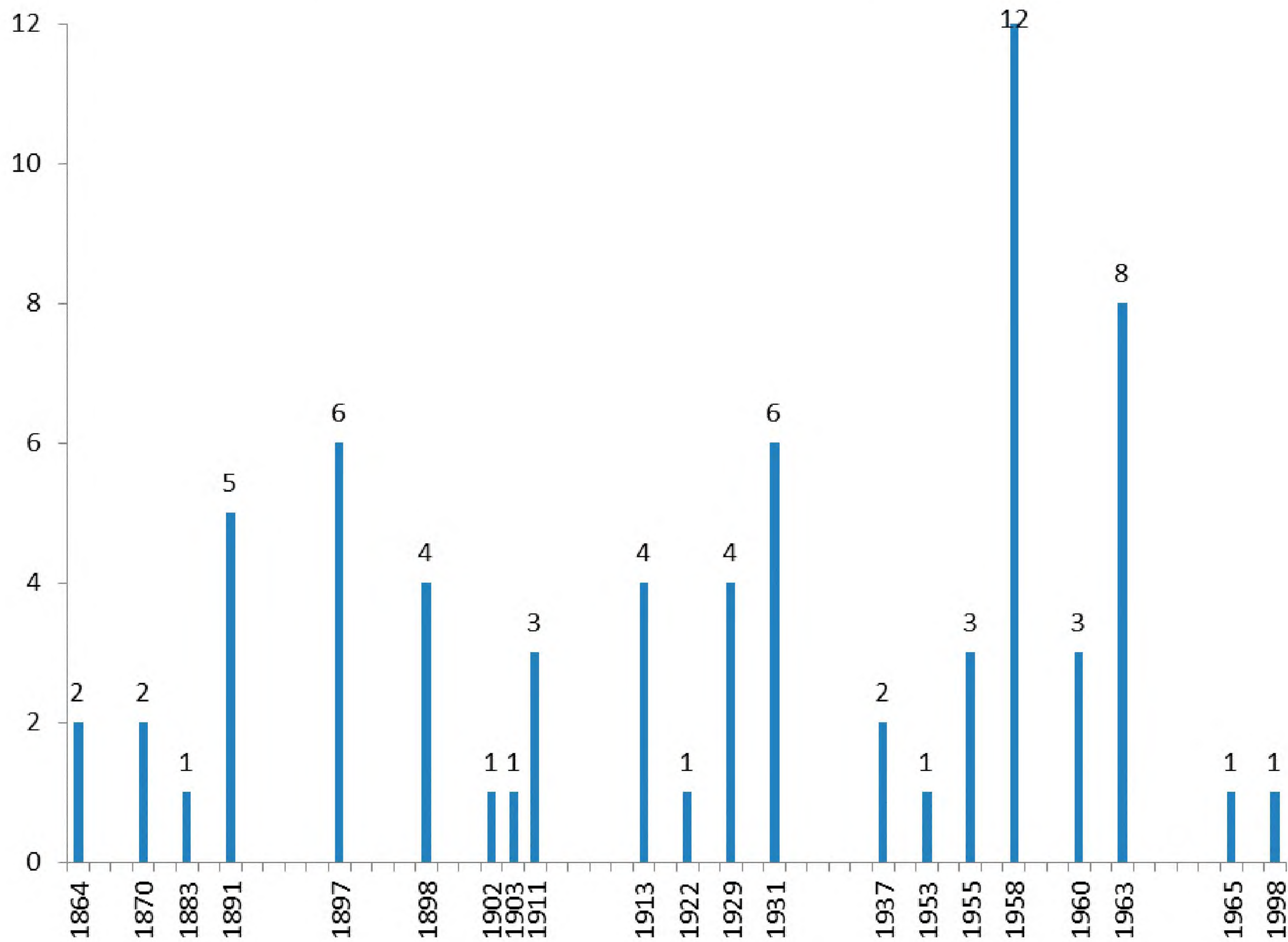


Figure 5. Chronological overview of Diplommatinidae descriptions from Wallacea and Papuan region (Sulawesi is excluded), 1864-1998.

Legends: x axis - years of publications; y axis - number of Diplommatinidae species described by years (please note the real number of species is lower since some of previously described taxa are synonymised in the present work).

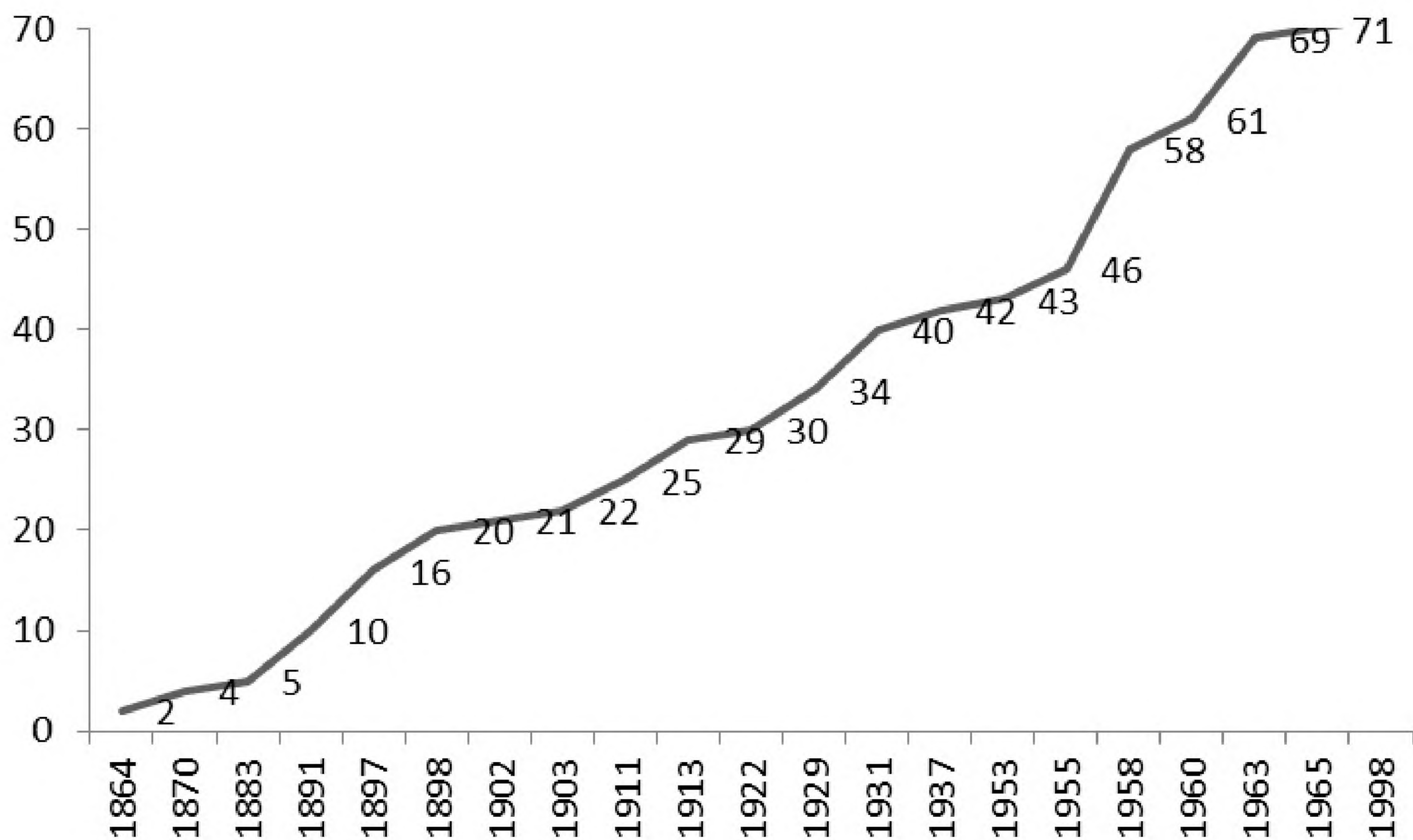


Figure 6. Cumulative number of Diplommatinidae descriptions from Wallacea and Papuan region by years (Sulawesi is excluded).

Legends: x axis - years of publications; y axis - number of Diplommatinidae species (please note the real number of species is lower since some of previously described taxa are synonymised in the present work).



Before this study, 71 diplommatinid species were reported from the study area (5 *Arinia* species, 3 *Diancta*, 14 *Diplommatina*, 6 *Moussonia*, 39 *Palaina* according to the generic concept used in this publication), among these 68 species (Fig. 6) considered endemic to the study area. Several of these species are synonymized in the present paper. For such a large and heterogeneous area, these numbers appear depauperate and probably result from the poorer sampling of the areas, especially when compared to the 42 species known from the much smaller Fiji Islands (Neubert & Bouchet

2015) and approximately 90 Diplommatinid species estimated from the even smaller Palau Islands (Rundell 2008)).

Prior to this study, Diplommatinidae material was available mainly from a limited number of mostly coastal localities (Table 1). Relatively high numbers of species were reported by earlier authors from Sumba (10 species), Misool (8), Flores (7) and northern New Guinea (7 species). This picture is changing significantly when taking into account newly discovered species described in this publication (Table 19).

Table 1. Geographical records of the Diplommatinidae from the study area prior to this study (Some of these species are synonymized with other ones in this publication).

Geographic island group	Island or part of a large island	Number of described taxa
Aru Islands		4
Bismarck Archipelago	New Britain	5
Lesser Sunda (Nusa Tenggara) Islands	Flores	7
	Lombok	1
	Sumba	10
The Moluccas (Aru & Tanimbar islands excluded)	Ambon	5
	Bacan	1
	Belangbelang	4
	Buru	2
	Haruku	3
	Obira	1
	Saparua	1
	Ternate	1
Louisiade Islands	Basilaki	1
New Guinea & Cenderawasih Bay Islands	North New Guinea	7
	Bird's Head (Doberai) Peninsula	1
	West Papua (without Bird's Head, Cenderawasih Bay islands)	4
	Biak, Owi & Yapen	6
Raja Ampat Islands	Misool	8
	Waigeo	1
Talaud Islands		1
Tanimbar Islands		4
Timor		1
Solomon Islands	Guadalcanal	1
	Nggela (= Florida)	3
	Mono	3
	Makira (= San Cristobal) & Owaraha (= Santa Ana)	2

Systematic part and new faunal information

Ten diplommatinid genera and subgenera represented by seventy one species ¹ were reported for the study area prior to my studies (Table 1). The following Diplommatinidae genera and subgenera (Egorov 2013) were reported from the study area prior to this study (Table 2; next page).

1 Some of these genera and species are synonymized with other taxa in the present revision.



Table 2. Diplommatinidae genera and species reported from the study area prior to this study (Taxa are arranged alphabetically).

Genus / subgenus according to previous authors	Initial number of species in the area	Reported from
<i>Anostomella</i> Martens, 1867	1	Lease Islands
<i>Arinia</i> s. str. H. et A. Adams, 1856 & <i>Arinia</i> (<i>Leucarinia</i>) von Möllendorff, 1893	6	Lesser Sunda Islands, Talaud Islands
<i>Diancta</i> s. str. Martens, 1864 = <i>Diancta</i> (<i>Eudiancta</i>) Kobelt et von Möllendorff, 1898	2	North Moluccas
<i>Diplommatina</i> Benson, 1849 (type genus) = <i>Diplommatina</i> (<i>Eudiplommatina</i>) Kobelt et von Möllendorff, 1898; = <i>Diplommatina</i> (<i>Sinica</i>) von Möllendorff, 1885	12	Lease Islands, North Moluccas, Aru Islands, New Guinea
<i>Diplommatina</i> (<i>Moussonia</i>) O. Semper, 1865	6	Central Moluccas, New Guinea
<i>Palaina</i> s. str. O. Semper, 1865 = <i>Palaina</i> (<i>Eupalaina</i>) Kobelt et von Möllendorff, 1898; = <i>Palaina</i> (<i>Cylindropalaina</i>) von Möllendorff, 1897	42	Lease Islands, North Moluccas, Solomon Islands
<i>Pseudopalaina</i> von Möllendorff, 1897	2	Lesser Sunda Islands

***Arinia* s. l. H. et A. Adams, 1856**

Type species: *Cyclostoma minor* G.B. Sowerby, 1843 (original designation)

Diagnosis: The dextral shell is cylindrical, conical or fusiform. Constriction before the tuba bears an internal transverse thickening without teeth. The aperture is not or only inconspicuously tilted upwards and lacks teeth or bears a tooth in the angular edge; rarely with the columellaris visible. The operculum with a corneous inner and a calcareous outer layer, multispiral, without concentric ridges (Vermeulen 1996a) but this character is variable among the Papuan and Wallacean taxa. According to Kobelt (1902) the tuba (the area beyond the constriction) extends half a whorl in *Arinia* and three quarters of a whorl in *Palaina*. However, this character is variable in both *Arinia* and *Palaina*. Subgenera of *Arinia* (Table 3) are poorly defined and not considered in this review.

Remark: Generic limits between *Arinia* and *Palai-*

na are not clear and additional data i.e. DNA sequence data will be required to more clearly define the two genera. I have not attributed any of my new species to *Arinia* since there is no comprehensive revision or good delimitation of generic characters for diplommatinids. I am not using the older genus (*Arinia*) versus later established *Palaina* primarily because I follow earlier authors on the Papuan Region who placed most of their species in *Palaina*. Distribution: Vietnam, West Malaysia, Borneo, the Philippines, Wallacea (Sulawesi; occurrence on Nusa Tenggara and Talaud Islands needs genetic confirmation), Aru Islands, Australia. The range of this genus in the east is not clearly ascertained because of insufficiently clear delimitation towards the genus *Palaina* O. Semper, 1865. Diversity in the study area: Five species hitherto confirmed (Table 4). Additional DNA studies required to confirm these species belong to *Arinia* or *Palaina*.

Table 3. Satellite taxa of *Arinia* H. et A. Adams, 1856 (according to Egorov 2013).

Taxon, author	Distribution
<i>Leucarinia</i> von Möllendorff, 1893	Borneo, the Philippines, Nusa Tenggara Wallacea (Sulawesi & Talaud Islands)
<i>Notharinia</i> Vermeulen, Phung et Truong, 2007	Vietnam, West Malaysia



Table 4. Characters matrix 1. Genus *Arinia* H. et A. Adams.

Legends: + present; – absent; 1/2 – character indistinct; ? – unknown; r = axial ribs on the penultimate whorl absent (0), straight (1), sinuous (2) or humped; rp = ribbing pattern widely-spaced throughout the teleoconch (1), dense (2) or ribbing pattern changing in different parts of the teleoconch (3); ss - spiral striae visible at 80x magnification (+) or not indicated (–); p = peristome is simple (1), double (2) or triple (3); d = dextral or s = sinistral.

Taxon \ Character	r	rp	ss	p	d / s
<i>Arinia blanda</i>	1/2	2	+	2	d
<i>Arinia crassiventris</i>	0	3	-	1	d
<i>Arinia patagiata</i>	3	3	-	2	d
<i>Arinia talautana</i>	1	1	+	2	d
<i>Arinia tjendanae</i>	0	3	-	3	d

***Arinia* (s. l.) *blanda* E.A. Smith, 1897** (Plate 30 figs 10-13)

Lectotype BMNH [herewith designated]: ~~Arina~~ [corrected by hand] *Arinia blanda*, Smith l. Flores, 4000 ft. SM 8.3.80-2 [handwritten] / *blanda*, Smith l. Flores [handwritten].

Paralectotypes 2 adults BMNH [herewith designated]: same labels as lectotype.

Lectotype designation: Paralectotypes and lectotype are selected from a lot of 3 syntypes, but this lot does not have any label saying these specimens are (syn)types (J. Ablett, personal communication).
References: Smith E.A. (1897a: 627); Kobelt & von Möllendorff (1898: 131), checklist, as *Arinia* Subgen. *Leucarinia* Mlldff. *blanda*; Kobelt (1902: 392), as *A.[rinia]* (*L.[eucarinia]*) *blanda*; Rensch B. (1931: 392).

Measurements: Lectotype H = 2.1, D = 1.1 mm, HW = 1.2 mm, PD = 0.7 mm.

Description: Shell is small, white, dextral, cylindrical with flattened apex. Shell with 5½ convex whorls, the 1⅓ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is slightly constricted in apertural view, slightly narrower than the penultimate whorl. The umbilicus is closed in adult. Whorls are oblique with regard to the coiling axis. The constriction is not defined on shell wall. The constriction is more or less centered in apertural view. The teleoconch whorls are sculptured with delicate dense straight to slightly sinuous axial ribs. The ribs becoming coarser and more widely spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 15-17 ribs per 0.5 mm. Spiral striae delicate and dense on early whorls, not or almost not indicated on the penultimate and ultimate whorls. The aperture is circular, apertural rim is entire. The aperture is tilted about 10° to the coiling axis. In apertural view the aperture is more or less central below the coiling axis. The peristome

is double, thin in lateral view, the inner and outer peristomes almost fused. The parietal margin of the peristome is attached to the ultimate whorl. The palatal margins of both peristomes are slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: Lesser Sunda Islands: Flores Island. Exact locality is unknown for this species, therefore a distribution map is not given.

Conservation status: Data Deficient, DD. There is not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated about 9000 km² taking into account the area of Flores and the distribution of remaining rainforests on this island. This species is known from the small type series collected from one locality over 120 years ago and has not been collected again. The population size and trend are unknown. The main threat is unknown for this speies. Between 2001 and 2014, Flores has lost over 17000 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), primarily in lowland forests. Further research is required to assess the distribution of this species, its population size, trend and threats.

***Arinia* (s. l.) *crassiventris* B. Rensch, 1931** (Plate 30 figs 18-20, map 12)

Holotype MHUB: Sunda-Expedition Rensch Fundort: [printed] Waingapoe, Sumba Kambera-Genist [handwritten] Datum: [printed] 27.7.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Arinia crassiventris* Rensch* Waingapoe, Sumba 27.7.27. Kambera Genist 75443 Rensch leg [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Arinia crassiventris* Rensch Zool. Jahrb. Syst., 61, p. 392, Fig. 18, 1931 [handwritten] [label red].

References: Rensch B. (1931: 392); Rensch B. (1933: 496); van Benthem Jutting (1958b: 94); Monk et al. (1997: 395).

Measurements: Holotype H = 4.2 mm, D = 3.05



mm, HW = 2.7 mm, PD = 1.7 mm.

Description: Shell is large, white, dextral, obese cylindrical with pointed apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is strongly constricted, it is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The penultimate and the ultimate whorls are oblique with regard to the coiling axis. The constriction is not defined on shell wall. The position of the constriction is unknown since the shell is not translucent. Teleoconch smooth on younger whorls, ribs extremely delicate and poorly defined as dense axial striation. The ribs are more distinct and more widely-spaced on the 2nd and 3rd whorls. There are no abrupt changes in the ribbing pattern. The ribs are oblique to the coiling axis. Spiral striae are lacking. The aperture is tilted about 15-20° to the coiling axis, semicircular, apertural rim is entire. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple, its columellar margin slightly sinuous. The parietal side of the peristome is pressed against the parietal wall, attached to it. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Specimens reported from light, dry secondary forest, collected under pieces of wood and in leaf litter.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO for this species. The current AOO is 8 km² but the maximum AOO is likely much higher. This species is known from a couple of specimens collected from two localities over 50 years ago. The population size and trend are unknown. The main threat is unknown for *Arinia crassiventris*. Further research is required to clarify status of this species in the wild, assess its distribution, population size and trend, and highlight threats.

***Arinia* (s. l.) *patagiata* van Benthem Jutting, 1958**
(Plate 30 figs 21-23, map 12)

Holotype NHMB: *Arinia patagiata* Stal. 575 Holotypus [handwritten] / 6078a Sumba, Waikarudi [printed] / HOLOTYPE [printed, label pink, glued on glass of the store box].

Paratype 1 subadult NHMB: *Arinia patagiata* nsp. Paratype [handwritten] / Naturhist. Museum Basel Coll. Dr. Bühler Dr. Sutter 1949 Waikarudi Sumba 575 [printed] / 6078 a Sumba, Waikarudi [printed] / PARATYPE [printed, label light green, glued on glass].

References: van Benthem Jutting (1958b: 94, pl. 1 fig. 1); Monk et al. (1997: 395).

Measurements: Holotype H = 2.9 mm, D = 1.65 mm, HW = 1.7 mm, PD = 1.4 mm.

Description: Shell is small, whitish, dextral, cylindrical with conical apex. Shell with 5¾ very convex whorls, the 2 embryonic whorls are microscopically pitted. The suture is very deep. The ultimate whorl is constricted, it is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not defined on shell wall. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, very widely-spaced, strongly sinuous and partly humping ribs. Upper parts of the ribs are bent to a coiling direction. The ribs becoming denser at the constriction, but are more widely spaced on the last half whorl. These changes in ribbing pattern are rather abrupt. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The margins of the inner peristome are not sinuous. The outer peristome is broadly discontinued parietally, broadly expanding beyond inner peristome and consists of few coarse lamellae, its palatal margin is not or slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Type specimens were sampled from creek valley from under decaying wood.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated at least 11100 km² taking into account the area of Sumba and adjacent islets. The population size and trend are unknown. The main threat for this species is unknown. It is likely that loss of the habitat is a very significant threat for this species, but this needs confirmation. Further research is required to clarify status of *A. patagiata* in the wild, assess its distribution, calculate population size, trend and highlight threats for this species.

***Arinia* (s. l.) *talautana* (Fulton, 1899)** (Plate 30 figs 14-17)

Lectotype BMNH [herewith designated]: Dip. (*Arinia*) *talautana* Fulton Talaut [sic!] Isl TYPE 48-12-3-227-229



[handwritten] / Type. [printed] / talautana, Fulton. Talaut. [handwritten].

Paralectotypes 4 adults [herewith designated]: 2 BMNH: same labels as lectotype; 2 FMNH: 25287 [printed] / 25287 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 2 dry spec. Syntype(s): Diplommatina (Arinia) talautana Fulton, 1899 Sta. FMNH25287, Indonesia, Talaut Islands ex W.F. Webb ex Sowerby & Fulton (Acc.# 7129) [printed].

Lectotype designation: Paralectotypes and lectotype are selected from a lot of 5 syntypes in BMNH and FMNH.

References: Fulton (1899: 214, 217, pl. 11 fig. 13), as *Diplommatina (Arinia) Talautana*; Kobelt (1902: 393), as *A.[rinia] (L.[eucarinia]) talautana*; Monk et al. (1997: 395).

Measurements: Lectotype H = 2.65 mm, D = 1.4 mm, HW = 1.5 mm, PD = 1 mm. Selected paralectotype from FMNH: H = 2.4 mm, D = 1.3 mm, HW = 1.4 mm, PD = 1 mm.

Description: Shell is small, whitish to creamy coloured, dextral, cylindrical with flattened apex. Shell with 5¼ convex whorls, the 1 embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is slightly constricted, as wide as the penultimate whorl in apertural view. The umbilicus is extremely narrowly open and perspective in adult. The constriction is poorly defined by a short impression. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with coarse, widely-spaced, straight ribs. The ribs becoming somewhat coarser and much more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls. The ribs are oblique to the coiling axis. There are about 9-11 ribs per 1 mm. Spiral striae are distinct, delicate and dense. The aperture is tilted about 10-15° to the coiling axis and is circular and has entire apertural rim. The aperture is slightly shifted right against the coiling axis in apertural view. The peristome is double, thin in lateral view and consists of a few strong lamellae. The parietal margin of the peristome is pressed against the shell wall, attached to the ultimate whorl. The margins of the inner peristome are not sinuous. The outer peristome broadly discontinued parietally. The palatal margin of the outer peristome is slightly sinuous. No specimens were available to study the internal lamellae. The operculum is derivative, with rather long hollow cylindrical median process on the outer surface.

Ecology: Unknown.

Distribution: Talaud Islands. Record from Ternate

(North Moluccas) by Monk et al. (1997: 395) is definitively an error. Distribution map is not given.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 4000 km² taking into account the area of Talaud Islands. This species is known from small type series sampled from one site over 120 years ago and has not been reported again. The population size and trend are unknown. Threats are unknown for this species. Further research is required to clarify status of *A. talautana* in the wild, assess the distribution, calculate population size, trend and highlight threats for this species.

Arinia (s. l.) **tjendanae** **B. Rensch, 1931** (Figs 37-38, 105a-b, 140-141, plate 29 figs 13-17, maps 12, 15)

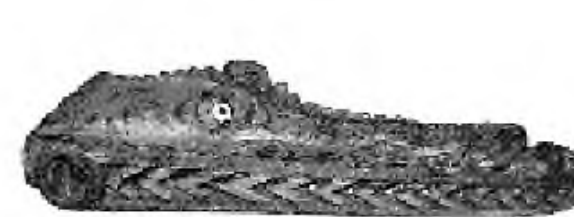
Syntypes 14 adults MHUB: Sunda=Expedition Rensch Fundort: [printed] Waingapoe, Sumba Kambera Genist [handwritten] Datum: [printed] 27.7.27 [handwritten] No. [printed] / Zoolog. Museum Berlin [printed] Arinia (Leucarinia) thendanae Rensch* Waingapoe, Sumba Kambera Genist 27.7.27 75446 Rensch [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] Arinia (Leucarinia) thendanae Rensch Zool. Jahrb. Syst., 61, P. 393, Fig. 19, 1931 [handwritten, label red].

Additional material 5 adults NMNL: Coll. J.J. Vermeulen, nr. 4147 Arinia cf. Tjendanae Rensch 1931 Diplommatinidae INDONESIA, Aru Islands, Pulau Kobroor, N. of Kobroor. Primary rainforest, base of outcropping fossil coral reef. Leg. H. Turner & M. v. Balgoolij, 25/04/1993.

References: Rensch B. (1931: 393), as *Arinia (Leucarinia) tjendanae*; Rensch B. (1933: 496), as *Arinia (Leucarinia) tjendanae*; van Benthem Jutting (1958b: 94); Vermeulen (1996c: 109, 112); Monk et al. (1997: 395).

Measurements: Selected syntype H = 1.8, D = 0.9 mm, HW = 0.9 mm, PD = 0.6 mm. All specimens from Aru Islands are generally larger: H = 2.1, D = 1 mm, HW = 1.15 mm, PD = 0.8 mm; H = 1.95, D = 0.9 mm, HW = 1.1 mm, PD = 0.8 mm.

Description: Shell is very small to small, white, dextral, high cylindrical with flattened apex. Shell with 5¼-5½ convex whorls, the 1½ embryonic whorl is smooth (no microscopic sculpture visible by 300x magnification). The suture is moderately deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by an inconspicuous impression and suture becoming somewhat deeper above the of constriction. The constriction is more or less centered in apertural view. Teleoconch smooth with very deli-



cate axial striations on both the penultimate and the ultimate whorls, but with very delicate and very widely-spaced straight axial ribs on earlier whorls. There are no abrupt changes in the ribbing pattern. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly triple in larger specimens (the outer peristome is double), double with less conspicuous median (third) lamella in smaller specimens. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. Peristomal margins are not sinuous. The columella is shiny and moderately broad with a small median knob (the knob is less conspicuous in smaller shells). Operculum is unknown.

Ecology: Specimens occur in moist rainforest soil and leaf litter, as well as under decaying wood. On Aru Islands this species inhabits base of limestone outcrops in primary lowland rainforests.

Distribution: Lesser Sunda Islands: Sumba Island; Aru Islands: Kobroor Island.

Conservation status: Data Deficient, DD. The EOO inclusive nearly 60 years old records is about 45000 km², but not enough data available to calculate the current EOO. The maximum EOO estimated at least 165000 km² and includes whole of Sumba and at least Kobroor of Aru Islands. The current AOO is 4 km², however the maximum AOO is likely

much higher. The population size and trend are unknown. According to van Benthem Jutting (1958b), this species was locally common on Sumba. The main threat to this species considered decline and altering of the habitat, but this needs confirmation. Further research is required to assess the distribution and calculate population size, uncover ecology of *A. tjendanae* and highlight threats for this species.

***Diancta* s. str. Martens, 1864**

Type species: *Diplommatina constricta* Martens, 1864b (by monotypy)

= subgenus *Eudiancta* Kobelt et von Möllendorff, 1898 (objective synonym)

Remark: The name *Eudiancta* was introduced by Kobelt and von Möllendorff (1898) as an unnecessary replacement for *Diancta*.

Diagnosis: The penultimate whorl is bulbous and the ultimate whorl is constricted. Internal lamellae apparatus conspicuous due to the presence of several longitudinal palatalis.

Distribution: From North Moluccas to Fiji. There are currently no records from New Guinea and the Solomon Islands. Subgenus *Paradiancta* von Möllendorff, 1895 occurs on the Philippines and Greater Sunda Islands (Borneo in particular) (Egorov 2013).

Diversity in the study area: Five species hitherto confirmed (Table 5).

Table 5. Characters matrix 2. Genus *Diancta* Martens.

Legends: + present; – absent; 1/2 – character indistinct; ? – unknown; r = axial ribs on the penultimate whorl straight (1) or sinuous (2); rp = ribbing pattern widely-spaced throughout the teleoconch (1), dense (2) or ribbing pattern changing in different parts of the teleoconch (3); ss - spiral striae visible at 80x magnification (+) or not indicated (–); p = Peristome is simple (1) or double (2); pt = number of palatalis (l - longitudinal, t - transverse); d = dextral or s = sinistral.

Taxon \ Character	r	rp	ss	p	pt	d / s
<i>Diancta constricta</i>	1/2	1	+	2	0	s
<i>Diancta halmaherica</i>	1	2	-	2	4(l)	s
<i>Diancta multiplicata</i>	1	2	-	2	?	s
<i>Diancta obiensis</i>	1	1	-	2	1(t)	s
<i>Diancta torta</i>	2	1	-	2	4(l)	s

***Diancta* (s. str.) *constricta* (Martens, 1864)** (Fig. 8, plate 19 figs 1-10, map 5)

Lectotype MHUB [herewith designated]: Ternate [handwritten] / Zoolog. Museum Berlin [printed, text bold & underlined] *Diplommatina constricta* Marts. * Ternate v. Martens 4826 a Martens leg [handwritten] / Zoolog. Museum Berlin [printed, text bold & underlined] *Diancta constricta* Marts. * Ternate Molukken 4826 b Martens [handwritten].

Paralectotypes 9 adults MHUB [herewith designat-

ed]: same labels as lectotype; 1 adult SMF [104 902]: Ternate [not studied] [two shells are broken].

Additional material: 4 adults, 2 juv. KGC: INDONESIA E, North Moluccas, Tidore Is., [outer slope of] caldera of Sabale volcano, 0°43'20"N, 127°26'16"E, 450-530 m, 29.VI.2013, secondary lowland rainforest, leaf litter, leg. K.Greke.

Lectotype designation: Syntype specimens of *D. constricta* in MHUB are glued on a paper card



and arranged in three rows by three specimens. The central specimen in the upper row (according to the position of shells - apex up) is selected as the lectotype.

References: Martens (1864a: 119), as *Diplommatina* Gruppe *Diancta constricta*; Pfeiffer (1865: 11); Martens (1867: 164, pl. 4 fig. 19), as *Diplommatina* Gruppe *Diancta constricta*; Nevill (1878: 290), as *Diplommatina* (*Diancta*) *constricta*; Ancey (1887: 278); Smith E.A. (1896: 121), checklist; Kobelt & von Möllendorff (1898: 135), checklist, as *Diancta* subgen. *Eudiancta constricta*; Kobelt (1902: 420); Wenz (1938: 483); Zilch (1953: 17, pl. 6 fig. 85); van Benthem Jutting (1959: 29, 50); Monk et al. (1997: 395); Egorov (2013: 25); Neubert & Bouchet (2015: 8).

Measurements: Lectotype H = 4.6 mm, D = 2.7 mm. Selected paralectotypes: H = 4.7 mm, D = 2.8 mm; H = 4.7 mm, D = 2.6 mm. Selected specimens from Tidore: H = 4.8 mm, D = 2.4 mm, HW = 2.2 mm, PD = 1.9 mm; H = 4.7 mm, D = 2.4 mm, HW = 2.7 mm, PD = 1.85 mm.

Description: Shell is large, creamy whitish to pale yellow, sinistral, elongate, and rather broadly conical. Shell with 6½ strongly convex whorls, the 1½ embryonic whorl is microgranulate. Shell apex is distinctly convex. The suture is rather deeply impressed. The penultimate whorl is large, strongly bulbous. The ultimate whorl is constricted, descending, it is much narrower than the penultimate whorl in apertural view. The well-defined and distinctly impressed constriction is situated in the middle of the abapertural side of the shell. The umbilicus is closed in adults. The teleoconch is sculptured with coarse, widely spaced and slightly sinuous axial ribs on the early and central whorls. The ribs are delicate and abruptly denser prior to the constriction becoming coarse and widely spaced on the last half of the ultimate whorl. The ribs are not or only partly synchronized with those on the previous whorls. The ribs are oblique to the coiling axis. There are 6-7 ribs per 1 mm, but 8-9 ribs on the apertural side of the ultimate whorl above the aperture. In fully grown specimens ribs becoming much higher (somewhat paddle-like) near the suture. Extremely delicate and very dense spiral striae on the teleoconch are visible at 48x magnification. The upper and lower sides of the penultimate whorl are more or less parallel in apertural view. Aperture is not tilted against the coiling axis, is circular (but columellar side is nearly straight in certain Tidore specimens), apertural rim is entire. The aperture is shifted left against the coiling axis in apertural view. The parietal margin of the peristome

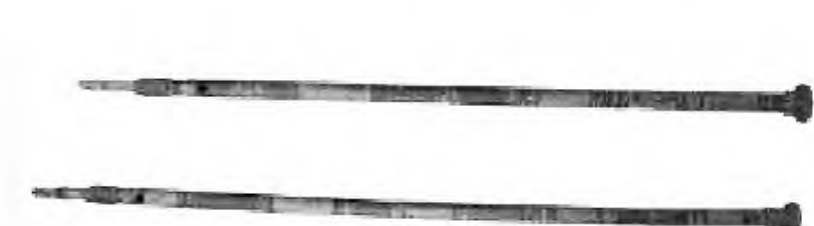
is attached to the ultimate whorl. The peristome is double (this is barely visible in old specimens). The inner peristome forms a continuous polished callus. The region beyond the outer peristome on the ultimate whorl is marked with dense high sinuous axial ribs. The outer peristome is somewhat angulate at palatal / parietal junction in fully grown specimens. No palatalis and parietalis present. The columella is shiny, obliquely twisted and forming a flat columellaris coiling into the interior of the shell. The operculum is circular, thick in lateral view, flat with spiral lines on the inner surface and with a broad hollow tubular projection on the outer side. The projection is constricted toward the apex.

Phylogeny: Tidore specimens of this species fall within clade E of Webster et al. (2012) and demonstrates some relationship with here described Papuan *Diplommatina telnovi* sp. nov. (consider chapter "Phylogeny").

Ecology: Tidore Island specimens were sampled from the underside of wet fallen leaves in leaf litter accumulated in a large depression in the rock. Specimens observed in shady and wet secondary lowland rainforest on the slope of an old, overgrown caldera (clay soil).

Distribution: North Moluccas: Ternate, Tidore.

Conservation status: Endangered, EN B1ab(i-ii), B2ab(iii). The current EOO is ~40 km², AOO - 12 km². This species is known from two small islands with active volcanoes with a dense and growing human population. It is likely *D. constricta* also occurs on neighbouring islands (for example, Hiri, Moti, and the western arms of Halmahera). This species' EOO and AOO are likely at least twice what is currently known, but definitively below 500 km² for AOO. This species was historically collected in primary forests, but is now limited to secondary forests (primary rainforest has not existed on either island for more than 100 years). The main threat is habitat loss as remaining secondary lowland rainforest is cleared due to the expansion of human settlements (on Ternate island), wood consumption for various purposes (on both Ternate and Tidore islands) and conversion of rainforest into gardens and plantations (on both Ternate and Tidore). Considering the size of the EOO and its location on active volcanoes (patches of rainforest only present on volcanic slopes above 400 m), a very large volcanic eruption on one of the islands may in theory destroy half of the current EOO (but considering the geological past of both Ternate and Tidore, such a super-eruption is very unlikely). This species is known from two locations. The population is not severely fragmented as the minimum distance between the islands is just 2.2



km. Despite the distance being so short, gene flow between subpopulations considered very low due to absence of the habitat (forests) along the coast. Snails can potentially travel on floating material between two islands, but absence of suitable habitats along the coastline makes re-colonization very difficult. Transportation by birds or human (with substrate or plants) from one island to another is the most realistic scenario for gene exchange. Continuing decline is observed in extent and quality of habitat. Remaining lowland rainforests on Ternate and Tidore to be protected and green corridors between remaining forest patches to be maintained. Further search for *D. constricta* localities is required on neighbouring Hiri, Mare, and Moti islands and on western Halmahera.

***Diancta* (s. str.) *halmaherica* sp. nov.** (Fig. 9, plate 20 figs 1-10, map 5)

<http://zoobank.org/EAEA5341-4486-4E36-9C14-058344ED1E02>

Holotype NME: INDONESIA, prov. Maluku Utara (North Moluccas), Halmahera tengah (Central), Weda Selatan dist., Loleo vill. SW env., Tilope vill. env., 0°13'58,16"N 127°54'27,18"E, 12.IX.2007, limestone cave, soil sample, leg. K.Greke.

Paratypes 6 specimens: 1 adult, 1 juv. KGC INDONESIA, prov. Maluku Utara (North Moluccas), Halmahera tengah (Central), Weda Selatan dist., Loleo vill. S env., Tilope vill. 10 km SW, way to Oham region, Gunung Talaga mt., ~100-150 m, 0°13'15,10"N 127°53'28,25"E, 13.IX.2007, primary & secondary lowland rainforest on limestone, leg. K.Greke; 1 adult & 1 juv. NME, 2 adults KGC: INDONESIA E, North Moluccas, central Halmahera, valley of creek Moreala E of Weda, 0°19'47"N, 127°49'57"E, 200-210 m, 06.VII.2013, primary lowland rainforest on limestone, leaf litter, leg. K.Greke.

Derivatio nominis: Toponymic. The name derives from the locus typicus, north Moluccan Island of Halmahera.

Measurements: Holotype H = 5.9 mm, D = 3 mm, HW = 2.4 mm, PD = 2.2 mm. Selected paratypic specimen from Tilope vill. env. H = 5.6 mm, D = 2.5 mm, HW = 2.4 mm, PD = 2 mm. Selected paratypic specimen from Moreala creek valley: H = 6.2 mm, D = 3 mm, HW = 2.8 mm, PD = 2.5 mm.

Description: Shell is large, pale brown to cream, sinistral, elongate, and rather narrowly conical with conical apex. Shell with 7-7½ moderately convex whorls, the 1½ embryonic whorl is smooth. The suture is rather deeply impressed. The penultimate whorl is slightly bulbous. The ultimate whorl is constricted and descending, in apertural view narrower than the penultimate whorl. The umbilicus is closed

in adults. The deep and well-defined constriction is located on the abapertural side of the shell. The teleoconch is sculptured with widely spaced, sinuous axial ribs on the early and central whorls (holotype specimen with almost straight ribs on the apertural side of the penultimate whorl). There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those on previous whorls. The ribs are oblique to the coiling axis. There are 10-12 ribs per 1 mm (specimens from Moreala creek valley have 11-12 ribs per 1 mm). Spaces between ribs are smooth to finely granulate, without spiral striae at 80x magnification. The upper and lower sides of the penultimate whorl are not parallel in apertural view. The aperture is not tilted against the coiling axis, is oval and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, the outer peristome has a wide zone of dense irregularly sinuous growth lines in left lateral view. The inner peristome forms a continuous polished callus, its margins are not sinuous. The outer peristome is shifted backward on basally. The palatal and basal margins of the outer peristome are strongly sinuous. Four long longitudinal palatalis present beyond the constriction. The columella is simple and broad. The operculum is circular, with spiral lines on the inner surface forming a short and broad hollow median tube on the outer surface.

Differential diagnosis: Compared to other Moluccan congeners, the shell of *Diancta halmaherica* sp. nov. is slender. The shells of *D. constricta* (Martens, 1864) and *D. torta* O. Boettger, 1891 are significantly broader. The upper and lower suture of the penultimate whorl of *D. halmaherica* sp. nov. are not parallel in apertural view. While the sutures of *D. constricta*, *D. multiplicata* von Möllendorff, 1902, *D. torta* are parallel or nearly parallel. The penultimate whorl of *D. halmaherica* sp. nov. is not or weakly bulbous unlike the strongly bulbous penultimate whorl of *D. constricta* and *D. torta*. The penultimate whorl is almost as wide as previous whorl in apertural view in *D. halmaherica* sp. nov. The penultimate whorl distinctly wider than the previous whorl in *D. constricta*, *D. multiplicata*, and *D. torta*. The constriction of the penultimate whorl is situated clearly abaperturally, not as in *D. constricta*, *D. multiplicata*, and *D. torta* where the constriction is shifted aperturally. In *D. torta*, the upper palatalis is shorter than the three lower palatalis while teeth have the same length in *D. halmaherica* sp. nov. The tubular projection of the operculum is



shorter and less broad in *D. halmaherica* sp. nov. than in *D. constricta*.

Ecology: Specimens inhabit in leaf litter of primary lowland rainforest on limestone soil and in secondary rainforest at the base of limestone rocks.

Distribution: North Moluccas: southern arm of Halmahera.

Conservation status: Vulnerable, VU B1ab(iii),-B2ab(iii). The current EOO is 14 km². The maximum EOO for this species is 4000 km² considering this species' possible distribution limit on the southern arm and in central Halmahera and the distribution of limestone soils in this region. The current AOO is about 8 km². It is very unlikely that this species occurs throughout central and southern Halmahera (but definitively not on SE arm of Halmahera where the research was carried out in 2013 by the Entomological Society of Latvia and this species was not found). Considering the amount of available habitat - primary and secondary lowland rainforest on limestone soil the AOO likely is higher but certainly below 500 km². Habitat loss and decline in habitat quality caused by logging, conversion of the forest into gardens and plantations, and expansion of settlements in lowland areas considered the main threats for this species. The forested part of the maximum EOO is decreasing. Between 2001 and 2014 about 16000 ha of the rainforest were lost in this area (calculated for 25% canopy density according to the Global Forest Watch (2016)) and this forest continues to decline in extent and quality. Considering the rapidly growing human population on Halmahera, this trend is likely to continue. The population is not severely fragmented. There are 2 locations. Further research on Halmahera is necessary in order to clarify species' distribution and assess its population size and trend.

***Diancta* (s. str.) *multiplicata* von Möllendorff, 1902** (Plate 19 figs 11-13)

Holotype SMF: *Diancta multiplicata* Mdf Obi [handwritten] / Senckenbg.Mus. [printed] 104901/1 [handwritten] Frankfurt-M. [printed] *Diancta* (*Diancta*) *multiplicata* Moellendorff [handwritten, underlined] Holotypus Obi-Inseln. Waterstraat S., Rolle H. [handwritten] Sammlung O.v.Moellendorff [printed].

Additional specimens: 3 specimens NMNL: *Diancta* 3504a *multiplicata* Mldff. Fruhst. 1004 [handwritten, black frame] / RIJKSMUSEUM NAT. HIST LEIDEN [printed] *Diancta multiplicata* Mldff. H.Fruhstorfer 1904 Obi eilanden [handwritten] / NCB Naturalis - Leiden [underlined] Diplommatinidae 40420 *Diancta multiplicata* Moellendorff RMNH.MOL.156217 [printed] / 2a [handwritten]; 1 specimen NMNL: [upper side of the label] *Diancta multiplicata* Mldff. Obi. [underside of the label]

Obi Fruhst [both sides handwritten].

References: von Möllendorff (1902: 194); Zilch (1953: 18, pl. 6 fig. 87); van Benthem Jutting (1959: 29, 50); Monk et al. (1997: 395).

Measurements: Holotype H = 6.2 mm, D = 2.5 mm, PD = 2.5 mm.

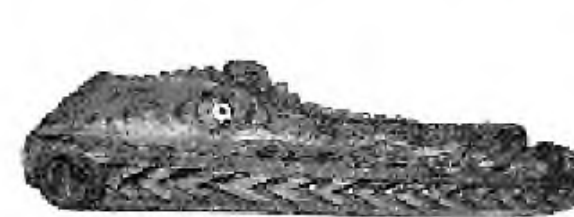
Description: Shell is large, pale yellow with orange coloured apical whorls, sinistral, elongate, and rather narrowly conical with conical apex. Shell with 6½ slightly convex whorls, the 1½ embryonic whorl is smooth. The suture is rather deeply impressed. The penultimate whorl is large and bulbous. The ultimate whorl is constricted, descending, it is narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is situated on the abapertural side of the shell, it is well defined by a short deep impression. The teleoconch is sculptured with delicate and dense axial ribs. The ribs on the 4th-5th whorls are strongly sinuous and more widely-spaced than on preceding or younger whorls. The ribs are denser and almost straight on both the penultimate and the ultimate whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 13 ribs per 1 mm, with finely granulate spaces between them and without any indication of spiral striae. The upper and lower sides of the penultimate whorl are more or less parallel in apertural view. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The parietal margin of the peristome is not fully attached to the ultimate whorl. The peristome is double, consists of dense irregularly sinuous lamellae. The inner peristome forms a continuous broad polished callus, its margins are not sinuous. The palatal margin of the outer peristome is slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: North Moluccas: Obi Islands. Exact locality is unknown, therefore a distribution map is not given.

Conservation status: Data Deficient, DD. This species is known from series of specimens collected more than 100 years ago and without exact locality data but island name known. This species has not been collected again. Its habitat and threats remain unknown. Further research is required to assess the distribution of this species, its population size, trend and threats.

Remark: Additional specimens from Obi in NMNL (van Benthem Jutting 1959) were not studied.



***Diancta* (s. str.) *obiensis* sp. nov.** (Fig. 10, plate 20
figs 11-14, map 5)

<http://zoobank.org/B7998F97-2A58-47F3-8A0A-D5F36BAD42BC>

Holotype UF (No 426418): UF 426418 Mollusca, Diplommatinidae 1-spec. *Palaina* sp. 12 Indonesia, Maluku Utara province Obi island, border of garden and rainforest 2.3 km N Woi gardens and rainforest 150 meters -1.7045° 127.6067° John Slacpinsky 26 Oct 2008, JDS-0942 dry FLORIDA MUSEUM OF NATURAL HISTORY [correct name for this locality is Wai].

Paratype 1 specimen UF: UF: 1 specimen UF 426396 Mollusca, Diplommatinidae 1-spec. *Palaina* sp. 12 Indonesia, Maluku Utara province Obi island, W shore of Danau Sagu, 8 km NNE of Kawassi burned forest 250 meters -1.5172° 127.4514° John Slacpinsky 23 Oct 2008, JDS-0941 dry FLORIDA MUSEUM OF NATURAL HISTORY [correct name for this locality is Kawasi].

Derivatio nominis: Toponymic. Named after the area of origin, Obi Islands in North Moluccas.

Measurements: Holotype H = 4.6 mm, D = 2.9 mm, HW = 2.3 mm, PD = 2 mm. Paratype: H = 5.1 mm, D = 2.8 mm, HW = 2.3 mm, PD = 2.1 mm.

Description: Shell is large, creamy whitish, sinistral, elongate, and rather broadly conical with conical apex. Shell with 6½ strongly convex whorls, the 1½ embryonic whorl is smooth. The suture is impressed. The penultimate whorl is large and bulbous. The ultimate whorl is constricted, descending, it is distinctly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is situated on the right side of the shell in holotype, but almost on the abapertural size of the shell - in paratype. On the early and the central whorls the teleoconch is sculptured with rather coarse and very widely-spaced, slightly sinuous axial ribs. The ribs becoming denser on the apertural side of the ultimate whorl, then appearing coarse and very widely-spaced again on the rest of this whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 7-9 ribs per 1 mm, but 10-11 ribs on the apertural side of the ultimate whorl. Spaces between ribs are finely granulate, without indication of spiral striae. The upper and lower side of the penultimate whorl are more or less parallel in apertural view. The aperture is tilted about 15° to the coiling axis and is circular (columellar rim is nearly straight) and has entire apertural rim. In apertural view aperture is strongly shifted left against the coiling axis. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, margins are not or slightly sinu-

ous. There is one distinct short transverse palatalis just before the constriction. The columella is broad and shiny. Operculum is unknown.

Differential diagnosis: Very similar to *Diancta torta* O. Boettger, 1891 (North Moluccas), but specifically differs in higher spire, less stronger bulbous penultimate whorl and in presence of single palatalis (four palatalis in *D. torta*).

Ecology: This species inhabits leaf litter of primary and secondary lowland rainforests, as well as gardens.

Distribution: Southernmost North Moluccas: Obi Islands, Obira Island.

Conservation status: Data Deficient, DD. This species is known from 2 localities. Not enough data available to calculate current EOO. The maximum EOO estimated below 5000 km² taking into account the area of Obi Islands. The current AOO is 8 km². The maximum AOO is likely much higher, but less than 500 km². The population size and trend are unknown. Currently there are two locations, but more than 5 locations are estimated when considering the maximum EOO. The main threat is habitat loss and decline in habitat quality caused by logging, mining, conversion of rainforest into gardens, plantations and settlements. The forested part of the maximum EOO has decreased between 2001 and 2014 and more than 14000 ha of rainforest were lost on Obira Island (calculated for canopy density over 25%, according to the Global Forest Watch (2016). Continuing decline in extent and quality of habitat is observed. Considering growing human population, this trend is likely to continue. Further research is required to assess the distribution of this species, its population size, trend and threats.

***Diancta* (s. str.) *torta* O. Boettger, 1891** (Plate 21
figs 1-5, map 5)

Lectotype SMF: (*Diancta*) *torta* n. sp. Insel Batjan. x D? Ad. Strubell 90. [handwritten] / Senckenbg. Mus. [printed] 104908/1 [handwritten] Frankfurt-M. [printed] *Diancta* (*Diancta*) *torta* Boettger [underlined] Lectotypus! T.4 F.6 Insel Batjan A. Strubell 1890 [handwritten] Sammlung O. Boettger [printed].

Paralectotypes 3 specimens SMF: *Diancta torta* Bttg xx Batjan [sic!] [handwritten, label yellow] / Senckenbg. Mus. [printed] 104909/3 [handwritten] Frankfurt-M. [printed] *Diancta* (*Diancta*) *torta* Boettger [underlined] Paratypen Insel Batjan A. Strubell d. [handwritten] Sammlung O.v.Moellendorff [printed].

References: Boettger O. (1891: 288); Smith E.A. (1896: 121), checklist; Kobelt & von Möllendorff (1898: 135), checklist, as *Diancta* subgen. *Eu-*



diancta torta); Kobelt (1902: 420); Zilch (1953: 18, pl. 6 fig. 86); van Benthem Jutting (1959: 29, 50); Monk et al. (1997: 395).

Measurements: Lectotype H = 4.1 mm, D = 2.5 mm, HW = 1.9 mm, PD = 1.7 mm. Selected paralectotypes: H = 3.6 mm, D = 2 mm, HW = 1.8 mm, PD = 1.45 mm; H = 3.4 mm, D = 2.2 mm, HW = 1.7 mm, PD = 1.4 mm.

Description: Shell is large, creamy whitish to pale yellow, sinistral, elongate, and rather broadly conical. Shell with $5\frac{3}{4}$ - $6\frac{1}{4}$ strongly convex whorls, the $1\frac{1}{2}$ embryonic whorl is smooth. Shell apex is distinctly convex. The suture is rather deeply impressed. The penultimate whorl is large, strongly bulbous. The ultimate whorl is constricted, descending, it is distinctly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is situated on the abapertural side of the shell, it is well defined by a short deep impression. The teleoconch is sculptured with coarse widely-spaced, slightly sinuous axial ribs on the earlier and the central whorls. The ribs becoming coarse and very widely-spaced on the last half whorl. There are abrupt changes in the ribbing pattern around the area of constriction - axial ribs becoming much denser here than on the rest of the shell. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 7 ribs per 1 mm, but 10-11 ribs on the apertural side of the ultimate whorl. Spaces between ribs are finely granulate, without indication of spiral striae. The upper and lower side of the penultimate whorl are more or less parallel in apertural view. The aperture is not tilted to the coiling axis and is circular (but the columellar side is nearly straight) and has entire apertural rim. The aperture is strongly shifted left against the coiling axis in apertural view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The peristome is double. The outer peristome consists of dense irregularly sinuous lamellae in lateral view. The margins of both peristomes are not or slightly sinuous. It is unclear if there is a parietalis (not visible through the shell wall in historical specimens). Four distinct transverse palatalis situated just before the constriction, of which upper one is considerably shorter than three another. The columella is

simple and broad. Operculum is unknown.

Ecology: Possibly this species inhabits leaf litter of lowland rainforests.

Distribution: North Moluccas: Bacan Island.

Conservation status: Data Deficient, DD. This species is known from 4 specimens collected more than 100 years ago from one locality and has never been collected again. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.

***Diplommatina* s. l. Benson, 1849**

Type species: *Bulimus folliculus* L.G.K. Pfeiffer, 1846 (original designation)

Diagnosis: Shell is more or less conical, either dextral or sinistral. The constriction contains teeth, the columellaris is present and usually visible in the aperture. According to Vermeulen & Whitten (1998), the constriction of *Diplommatina* contains two or more longitudinal teeth. The operculum lacks spiral ridges in studied Papuan taxa but often with spiral lines. Based on the presence of the columellaris, Vermeulen (1993) suggested *Diplommatina* may be a monophyletic group. Genetic data supports this assertion (Webster et al. 2012).

Remark: This genus is conchologically aberrant and polymorphic. As a result, numerous attempts have been made to split *Diplommatina* into smaller genera and subgenera (Table 6; next page). The set of conchological characters used to establishing these groups appear polyphyletic with some species sharing many characters and others only a few of them. I generally follow Vermeulen (1993) in my revision and do not use many of the subgenera for *Diplommatina*, except for *Diancta* Martens, 1864 and *Moussonina* O. Semper, 1865 which I consider good genera. Further data from anatomical or molecular studies are needed to test shell characters used to define these groups.

Distribution: This genus has the largest distribution of all Diplommatinidae extending from India in the west to Fiji in the East, from Japan and China in the north to Australia in the South.

Diversity in the study area: Twenty-two species hitherto confirmed (Table 7; next page).



Table 6. Satellite taxa of *Diplommatina* Benson, 1849 other than *Diancta* Martens, 1864 and *Moussonia* O. Semper, 1865 (according to Egorov 2013).

Taxon, author	Distribution
<i>Angigaster</i> Pilsbry, Hirase, 1904	Japan: Ryukyu Islands
<i>Benigoma</i> Kuroda, 1928	Japan
<i>Diploptycha</i> von Möllendorff, 1895	The Philippines: Luzon Island
<i>Eclogarinia</i> Iredale, 1933	Australia
<i>Gastroptycha</i> Kobelt et von Möllendorff, 1900	E India (Assam), China, the Philippines, Malaysia, W Indonesia
<i>Metadiancta</i> von Möllendorff, 1898	E India
<i>Sinica</i> von Möllendorff, 1885 (= <i>Euadnita</i> Iredale, 1941)	India, China, Indochinese Peninsula, Japan, Papuan Region

Table 7. Characters matrix 3. Genus *Diplommatina* Benson.

Legends: + present; – absent; +/- or 1/2 – character indistinct; ? – unknown; r = axial ribs on the penultimate whorl straight (1) or sinuous (2); rp = ribbing pattern widely-spaced throughout the teleoconch (1), dense (2) or ribbing pattern changing in different parts of the teleoconch (3); ss - spiral striae visible at 80x magnification (+) or not indicated (-); l = axial ribs developed in a form of lamellae (+) or not (-); u = umbilicus open (+) or closed (-); p = Peristome is simple (1) or double (2); pt = number of palatalis; prt = number of parietalis; d = dextral or s = sinistral.

Taxon \ Character	r	rp	ss	l	u	p	pt	prt	d / s
<i>Diplommatina baliana</i>	1	2	+	-	-	2	2	1	d
<i>Diplommatina decollata</i>	1	2	+	-	-	?	?	?	d
<i>Diplommatina floresiana</i>	2	1	-	-	-	2	1	1	s
<i>Diplommatina floris</i>	1	2	-	-	-	2	?	?	d
<i>Diplommatina fluminis</i>	1	1	-	-	-	2	0	1	d
<i>Diplommatina javana</i>	1/2	2	+	-	-	2	0	1	s
<i>Diplommatina jonabletti</i>	1	3	-	-	-	2	1	1	s
<i>Diplommatina leucopsis</i>	1	1	-	-	-	2	?	?	d
<i>Diplommatina lombockensis</i>	1	1	-	-	+/-	2	?	?	s
<i>Diplommatina lucifuga</i>	1	1	+	-	-	2	?	?	d
<i>Diplommatina maibrat</i>	1	2	+	-	-	2	1?	?	s
<i>Diplommatina mertoni</i>	1	2	+	-	-	2	3	1	d
<i>Diplommatina moluccensis</i>	1	2	-	-	-	2	2	0	d
<i>Diplommatina patani</i>	2	2	+	+	-	2	1	1	d
<i>Diplommatina radiiformis</i>	2	2	+	+/-	-	2	1	0	d
<i>Diplommatina slapcinskyi</i>	2	1	+	+		2	1	1	d
<i>Diplommatina smithi</i>	1	2	+	-	-	2	1	?	s
<i>Diplommatina symmetrica</i>	1	1	+	-	-	2	1	1	d
<i>Diplommatina telnovi</i>	2	2	+	-	-	2	3	1	d
<i>Diplommatina timorensis</i>	1	2	+	-	+	1	0	1	d
<i>Diplommatina torquilla</i>	1	1	+	-	-	2	?	?	d
<i>Diplommatina waigeoensis</i>	1/2	2	+	-	-	2	1	1	s

***Diplommatina* (s. l.) *baliana* Fulton, 1899** (Plate 21 figs 6-9)

Syntypes *D. baliana*, 3 adults BMNH: *Diplommatina baliana* Fulton Bali Isl. [handwritten] / Prob Syntypes label in Fultons hand - JDA 2016 [handwritten].

Additional material: 2 adults KGC: INDONESIA, Bali Is., Gunung Mesehe mt., 08°17'29.9"S, 114°41'49.4"E, 460 m, 17.III.2011, primary lowland rainforest, soil sample No 2, leg. A.Riedel; 5 adults KGC & 6 adults NME: INDONESIA, Bali Is., Gunung Mesehe mt., 08°17'40.3"S, 114°41'42.4"E, 515 m, 17.III.2011, primary lowland rainforest, soil sample No 3, leg. A.Riedel; 2 adults KGC & 2 adults NME: INDONESIA, Bali Is., Gunung Mesehe mt., 08°17'46.6"S, 114°41'33.1"E, 490 m, 17.III.2011, primary lowland rainforest, soil sample

No 4, leg. A.Riedel; 1 adult KGC: INDONESIA, Bali Is., Gunung Mesehe mt., 08°16'45.4"S, 114°41'72.5"E, 825 m, 18.III.2011, primary lowland rainforest, soil sample No 8, leg. A.Riedel; 1 adult KGC: INDONESIA, Bali Is., Gunung Batukaru mt., 08°21'98"S, 115°05'94.5"E, 945 m, 31.III.2011, primary lowland rainforest, soil sample No 2, leg. A.Riedel; 6 adults KGC & 6 adults NME: INDONESIA, Bali is., Primatani Nature park, Telaga, Busungbiu - Pupuan, 08°17'32.6"S, 114°56'67.1"E, 630 m, 02.IV.2011, primary lowland rainforest, soil sample No 1, leg. A.Riedel; 3 adults KGC: INDONESIA, Bali Is., Primatani Nature park, Telaga, Busungbiu - Pupuan, 08°17'30.4"S, 114°56'63.5"E, 625 m, 02.IV.2011, primary lowland rainforest, soil sample No 2, leg. A.Riedel.



References: Fulton (1899: 213, 216) as *Diplommatina Baliana*; van Benthem Jutting (1928: 154); Rensch B. (1931: 386), as *Diplommatina (Dipl.) baliana*; van Benthem Jutting (1958b: 95); Monk et al. (1997: 395), as *Diplommatina cyclostoma*; Vermeulen & Whitten (1998: 47, 138), proposed synonymy with *D. cyclostoma*; Nurinsiyah & Hausdorf (2017: 222-225), revised status.

Measurements: Selected syntype H = 2.5 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.8 mm.

Description: Shell is small, whitish or pale orange, dextral, narrow and high conical with convex apex. Shell with 6-6½ convex whorls, the 1½ embryonic whorl is smooth. The suture is rather deeply impressed. The penultimate whorl inconspicuously bulbous, it is slightly wider than the ultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short and shallow impression and the suture becoming deeply impressed above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with dense and rather coarse straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 12 ribs per 0.5 mm. Spiral striae are delicate and dense. The aperture is tilted about 20° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a broad polished callus on the palatal, basal and columellar sides. The peristome is double, consists of numerous flat sinuous axial lamellae in lateral view. The inner peristome somewhat sinuous at the parietal / palatal junction. The palatal margin of the outer peristome is slightly sinuous at the parietal / palatal junction. There is one parietalis. There is one long longitudinal palatalis positioned opposite the columellar side of the aperture and one transverse palatalis. The columellar denticle distinct, not directed downwards. Operculum is unknown.

Ecology: Specimens inhabit leaf litter and vegetation in primary and secondary lowland to mid-montane rainforests. Observed on both limestone and volcanic soils from lowlands up to 2900 m.

Phylogeny: As a result of COI analysis of specimens from East Java, this species represents same clade with *Diplommatina* species from mainland Asia (e.g. Malay *D. demorgani* Laidlaw, 1949 & Siamese *D. hidagai* Panha, 1997) and Sumatra (*D. canaliculata* von Möllendorff, 1886 & *D. ventricu-*

lus von Möllendorff, 1891).

Distribution: Java, Madura; Lesser Sunda Islands: Bali, Sumba. No exact locality is known from Sumba, therefore a distribution map is not given.

Conservation status: Least Concern, LC. The current EOO is about 150000 km². The current AOO is about 160 km², however the maximum AOO likely be significantly higher. This species inhabits lower to mid montane rainforests in Java and Bali (primarily because of degraded or absent habitat at lower altitudes). No information is available on population size and trend, but on Bali this species is not rare in suitable habitat. The main threat for this species was not identified. This species is widespread compared to most other Diplommatinidae. The population on Java is severely fragmented (Nurinsiyah & Hausdorf 2017), but this is not the case with Bali. Population fragmentation grade is unknown for Sumba and Madura, since the single record is currently known from each of these islands. There are at least five locations. Further research is required to highlight threats for *D. baliana*.

***Diplommatina* (s. l.) *decollata* van Benthem Jutting, 1958** (Plate 21 figs 10-13, map 13)

Holotype NHMB: Holotypus [handwritten] / *Diplommatina* St.682 Holotypus *decollata* [handwritten] / Zoölog. Museum. Amsterdam. [printed] no. 682 *Diplommatina decollata* (n. sp.) Langgaliru. Zentral Sumba ± 430 m. Höhe 27.ix-14.x.1949 Sumba Exp. 1949 [handwritten] / HOLOTYPUS [printed, label pink, glued on glass] / 6079 a Sumba, Langgaliru [printed].

Paratypes 40 specimens NHMB: 33 adults, 5 juv.: *Diplommatina decollata* n. sp. [handwritten] / Zoölog. Museum. Amsterdam. [printed] no. 308 *Diplommatina decollata* n. sp. Mau Maru, Ost Sumba ± 520m. Höhe 18-23 Juli 1949 Sumba Expedition 1949 [handwritten] / 5 St. Zool.Mus. Amsterdam [handwritten] / Naturhist. Museum Basel Coll. Dr. Bühler Dr. Sutter 1949 Mau Maru Sumba 308a [printed] / 6079 b Sumba [printed] / PARATYPOIDE [printed, label light green, glued on glass] [correct name for this locality is Mau Maru]; 2 adults: 6079 a Sumba, Langgaliru [printed] / PARATYPOIDE [printed, label light green, glued on glass] / Paratypen [handwritten].

References: van Benthem Jutting, (1958b: 95, pl. 1 fig. 2); Monk et al. (1997: 395).

Measurements (adult shells are decollate): Holotype H = 2 mm, D = 0.9 mm, HW = 0.8 mm, PD = 0.68 mm. Selected paratypic specimens from Mau Maru: H = 2 mm, D = 0.9 mm, HW = 0.8 mm, PD = 0.6 mm; H = 1.8 mm, D = 0.8 mm, PD = 0.57 mm. Description: Shell is small, corneous, dextral, narrow and high conical. Shell apex is convex in juvenile (non decollate) specimens. Shell with 5-6 slightly



convex whorls (adult shell is decollate). The suture is moderately deeply impressed. The ultimate whorl is constricted, it is strongly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a very shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense, straight axial ribs. The ribs becoming somewhat more widely-spaced on the ultimate whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 12-13 ribs per 0.5 mm. Spiral striae are very delicate. The aperture is tilted about 10° to the coiling axis and is circular and has entire apertural rim. The aperture is slightly shifted right against the coiling axis in apertural view. The parietal margin of the peristome is completely attached to the ultimate whorl. The peristome is double, thin and consists of a few close-standing lamellae in lateral view. The margins of the inner peristome are not sinuous. The palatal margin of the outer peristome is sinuous. There is one distinct columellar denticle, not directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: This species inhabits both primary and secondary lowland rainforests, found both in seasonally dry and year-round wet habitats in leaf litter, on and under decaying wood.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. This species is currently known from three localities. The current EOO is 43 km². The maximum EOO estimated about 10000 km² taking into account the area of Sumba Island and forested area. The current AOO is 12 km², but the maximum AOO is likely higher, but definitively below the threshold of 500 km². This species inhabits both primary and secondary rainforests under various soil humidity conditions (year-round wet and seasonally dry). Threats for this species are not fully understood. Habitat loss considered the main threat, but since *D. decollata* also reported from degraded forests, the importance of this threat remains to be clarified. Population fragmentation grade is not clear. There are at least two locations. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.

***Diplommatina* (s. l.) *floresiana* E.A. Smith, 1897**

(Fig. 112, plate 22 figs 1-7, map 12)

Lectotype BMNH [herewith designated]: *Diplom. Floresiana* Sm. S. Flores. 4000 ft. 97.8.3.75-4 [handwritten] / *Floresiana*, Smith I. Flores [handwritten].

Additional material: 4 adults KGC: INDONESIA, Nusa Tenggara, Flores Is., Ranamese Lake, 08°37.024'S, 120°33'40"E, 1270 m, 08.III.2011, primary lower montane rainforest, soil sample No 3, leg. A.Riedel; 3 adults KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°38.099'S, 120°31.745'E, 2205 m, 09.III.2011, primary mid montane rainforest, soil sample No 3, leg. A.Riedel.

Note: *D. floresiana* was described from 5 specimens (3 adults & 2 juv.). In the description, Smith E.A. (1897a: 626) described axial ribbing pattern as “oblique tenuiter costellata” but has not specified how dense the axial ribs are. Later, in the same description Smith pointed on “variability” of the aforementioned character: “In one specimen the riblets near the constriction of the body-whorl are much closer together than those upon the rest of the shell”. In fact, of three adult shells two have denser ribs on the ultimate whorl above the aperture. The type series of *D. floresiana* consists of two distinct but conchologically similar species. The true *D. floresiana* is presented only by the lectotype I herewith designate. Two other adult shells with denser ribbed ultimate whorl are herewith designated as paralectotypes and described below as *D. jonabletti* sp. nov. Both species share same habitat on Flores Island and are also represented in recently collected material. It is impossible to properly identify and assign to species the two juv. paralectotypes [herewith designated] of *D. floresiana*'s type series. The ultimate whorl and the constriction are not developed in these specimens and important diagnostic characters are therefore not present. These two shells are supplemented with a label “*Diplommatina* sp. det. K.Greke, 2016”.

References: Smith E.A. (1897a: 626); Kobelt & von Möllendorff (1898: 139), checklist, as *Diplommatina* subgen. *Pseudopalaina floresiana*; Rensch B. (1931: 389), as *Diplommatina* (*Pseudopalaina*) *floresiana*; Kobelt (1902: 452), as *Diplommatina* (*P.[seudopalaina]*) *floresiana*; Rensch B. (1931: 389), as *Diplommatina* (*Pseudopalaina*) *floresiana*. Measurements: Holotype H = 3 mm, D = 1.75 mm, HW = 1.6 mm, PD = 1.3 mm. Selected specimens from Lake Ranamese env.: H = 3 mm, D = 1.8 mm, HW = 1.6 mm, PD = 1.25 mm; H = 2.9 mm, D = 1.6 mm, HW = 1.6 mm, PD = 1.25 mm. Selected specimens from Ranaka mt.: H = 2.85 mm, D = 1.65 mm, HW = 1.5 mm, PD = 1.2 mm; H = 2.9



mm, D = 1.8 mm, HW = 1.6 mm, PD = 1.3 mm.

Description: Shell is small, corneous to pale reddish, sinistral, obese with convex apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microstriae. The suture is rather deeply impressed. The ultimate whorl is nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a very shallow impression and minor changes in ribbing pattern (few of the ribs are placed denser at the constriction). The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, widely-spaced, slightly sinuous to almost straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 6-7 ribs per 1 mm, but they become somewhat more widely-spaced on the apertural side of the ultimate whorl. Spiral striae are lacking. The aperture is slightly tilted to the coiling axis, subquadrate and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, with obtuse angulations on the palatal and columellar sides. The palatal and basal margins of both tperistomes are sinuous. Both the inner and the outer peristomes reflexed on the palatal (strongly), basal and columellar sides. There is one acute parietalis. There is one short longitudinal palatalis situated above the columellar side of the aperture. There is one distinct narrow columellar denticle directed downwards in fully grown specimens (but also can be more or less strongly reduced). The operculum is primitive - circular and without concentric ridges.

Ecology: Specimens inhabit wet leaf litter and the underside of decaying wood. This species occurs in primary lower to mid montane rainforests and was reported from altitudes of 1200-2205 m. Both recent and historical material comes from areas on volcanic soils.

Distribution: Lesser Sunda Islands: Flores Island. Record from southern Sulawesi (Rensch B. 1931), almost certainly based on misidentified specimen, was not included into the checklist of Sulawesi terrestrial molluscs (Maassen 1997) and needs further confirmation.

Conservation status: Near Threatened, NT. The current EOO is around 1000 km². The maximum EOO estimated about 15000 km² taking into account the area of Flores Island (13540 km²) and adjacent islands. The current AOO is about 12 km²,

however the maximum AOO likely be much higher since this species is underresearched, but definitively below 500 km². No information is available on population size or population trends, but in certain areas *Diplommatina floresiana* is not uncommon. This species inhabits moist litter of lower to mid montane rainforests and is not found in arid and deforested lowlands. The population is not severely fragmented, but fragmentation is likely to increase. Main threats for this species are Habitat loss and alteration due conversion of the rainforests into gardens as well as timber collecting and small-scale logging. Growing human population on Flores combined with more frequent and longer dry periods caused by global warming and El Niño weather patterns will likely have continued negative effect on the remaining natural rainforests of Flores. Between 2001 and 2014, Flores, its adjacent islands of Lembata, Adonara, Solor and Rinca lost almost 29000 ha of primarily lowland forest (calculated for canopy density over 25% according to the Global Forest Watch (2016). Human population is not spreading significantly from the lowlands to the montane areas, but wet mountains are primarily threatened by expanding small-scale gardens and logging for construction purposes. These trends are likely to cause a continuing decline in the AOO and extent of the habitat. Currently there are three locations for *D. floresiana*. The human population is not encroaching on the habitat yet, but a continuing decline in the near future is projected based on the known trend of forest loss because of human activities and climate change. Further research is required to assess the distribution of this species, its population size, trend and threats.

***Diplommatina* (s. l.) *floris* B. Rensch, 1931** (Fig. 13, plate 23 figs 1-6, map 12)

Holotype MHUB: Sunda-Expedition Rensch Fundort: [printed] Waë Renó (1000 m) W. Flores [handwritten] Datum: [printed] 25.6.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica) *floris* Rensch * Waë Reno, W. Flores 1000m 75429 Rensch [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Diplommatina* (Sinica) *floris* Rensch Zool. Jahrb. Syst., 61, p. 387, Fig. 12, 1931 [handwritten] [label red].

Paratypes 3 adults MHUB: Sunda-Expedition Rensch Fundort: [printed] Waë Renó (1000 m) W. Flores [handwritten] Datum: [printed] 25.6.27 [handwritten] No: [printed] / Dipl. (Sinica) *floris* Paratypen. Rensch [handwritten] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica) *floris* Rensch Waë Renó, W. Flores 1000m 75430 Rensch [handwritten].



References: Rensch B. (1931: 387), as *Diplommatina (Sinica) floris*.

Measurements (adult shells are decollated): Holotype H = 2.1 mm, D = 1.05 mm, HW = 1 mm, PD = 0.7 mm. Selected paratype H = 2.1 mm, D = 1 mm, PD = 0.8 mm.

Description: Shell is small, white, dextral, narrow fusiform. Shell with 5½ convex whorls (adult shell is decollated), number of embryonic whorls is unknown. The suture is moderately deeply impressed. The ultimate whorl is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a very shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, dense, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are straight to the coiling axis. There are about 23-25 ribs per 0.5 mm. Spiral striae not visible at 80x magnification, but is present according to the original description. The aperture is not tilted to the coiling axis and is circular has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. Peristomal margins are not sinuous. One distinct broad columellar denticle, not directed downwards. No specimens were available to study the internal lamellae of the shell, but one transverse palatalis is visible through the shell wall. The columella is obliquely twisted, forming an oblique median columellaris. Operculum is unknown.

Ecology: According to the original description, this species occurs in leaf litter of primary [montane] rainforests.

Distribution: Lesser Sunda Islands: Flores Island. Conservation status: Data Deficient, DD. Currently not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 9000 km² taking into account the area of Flores and present distribution of mid montane rainforests on this island. This species is known from a series of specimens collected from one locality over 80 years ago and has not been collected again. The population size and trend are unknown. The main threat to this species is likely to be habitat alteration. Between 2001 and 2014, Flores has lost over 17000 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), primarily in

lowland forests. Further research is required to assess the distribution of this species, its population size, trend and threats.

***Diplommatina* (s. l.) *fluminis* B. Rensch, 1931** (Fig. 11, plate 23 figs 7-13, map 12)

Holotype MHUB: was not available for this study.

Paratypes 13 adults MHUB: Sunda-Expedition Rensch Fundort: [printed] Waingapoe, Sumba Kambera-Genist [handwritten] Datum: [printed] 27.7.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed, underlined] Diplommatina (Sinica ?) fluminis Paratypen! Rensch Waingapoe, Sumba KamberaGenist 75437 Rensch [handwritten].

Additional material 2 adults MHUB: Zoolog. Museum Berlin [printed, underlined] 79579 Diplommatina fluminis B. Rensch Genist bei Noilmina W. Timor Ig. Stein 1.II.32 [handwritten].

References: Rensch B. (1931: 388), as *Diplommatina (Sinica ?) fluminis*; Rensch (1933: 496), as *Diplommatina (Sinica ?) fluminis*; Rensch B. (1935: 312, 314); Forcart (1936: 138), as *Diplommatina (Sinica) fluminis*; van Benthem Jutting (1958b: 95); Monk et al. (1997: 395); Vermeulen & Whitten (1998: 49, 138).

Measurements: Five selected paratypes (all adult shells are decollated): H = 1.7 mm, D = 0.9 mm, PD = 0.6 mm; H = 1.7 mm, D = 0.9 mm, PD = 0.6 mm; H = 1.9 mm, D = 0.9 mm, PD = 0.6 mm; H = 1.7 mm, D = 0.8 mm, PD = 0.55 mm; H = 1.85 mm, D = 0.9 mm, PD = 0.6 mm;

Description: Shell is very small, white, slightly translucent, dextral, narrow fusiform. Shell with 5½ strongly convex whorls, number of embryonic whorls is unknown. The suture is deeply impressed. The penultimate whorl is bulbous. The ultimate whorl is constricted and ascending, it is narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short and shallow impression. The constriction is situated beyond the aperture in apertural view. The teleoconch is sculptured with coarse, very widely-spaced, straight or slightly sinuous axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are straight to the coiling axis. There are about 5 ribs per 0.5 mm. The ribs becoming twice denser on the apertural side of the ultimate whorl. Spiral striae are not visible at 80x magnification, but is present according to the original description. The aperture is slightly tilted to the coiling axis and is circular and has entire apertural rim. The aperture is slightly shifted right against the coiling axis in apertural view. The



parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The inner peristome forms a continuous narrow polished callus. Margins of both peristomes are not sinuous. There is one parietalis. The columella is thin, obliquely twisted, forming an oblique columellaris in its basal third. One distinct broad columellar denticle, not directed downwards. Columellar denticle is double in certain paratypes (see Plate 23 fig. 13). Operculum is unknown.

Ecology: This species inhabits both primary and secondary lowland rainforests and was found in leaf litter and under decaying wood in both seasonally dry and year-round wet habitats, as well as in riverside debris. It is also reported from agricultural land (Vermeulen & Whitten 1998). It occurs from sea level up to 800 m and prefers limestone soils.

Distribution: Bali, Nusa Penida. Lesser Sunda Islands: Flores Island, Sumba Island, western part of Timor Island.

Conservation status: Data Deficient, DD. The current EOO is about 100000 km². The current AOO is about 28 km², but the maximum AOO is likely much higher. The maximum EOO for this species estimated about 150000 km² considering its large distribution area. This species seems not rare, but the population size and trend are unknown. The main threat cannot be identified (especially considering the fact that *D. fluminis* is also found in secondary rainforest and in agricultural land). Further research is required to assess the distribution of this species, its population size, trend and threats. Note: It is likely specimens from Bali and Nusa Penida belong to different, yet undescribed species since columellar denticle is less prominent and smaller in these specimens and their shells are less slender than in specimens from Lesser Sunda Islands.

***Diplommatina* (s. l.) *javana* von Möllendorff, 1897**
(Fig. 12, plate 23 figs 14-18, map 13)

= *Diplommatina javana orientalis* B. Rensch, 1931 (Plate 23 figs 14-18)

Holotype *Diplommatina javana orientalis* MHUB: Sunda-Expedition Rensch Fundort: [printed] Geli Moetoe (1300 m) Flores [handwritten] Datum: [printed] 21.7.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica) *javana orientalis* Rensch * Geli Moetoe W. Flores 1300m. 75431 Rensch [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Diplommatina* (Sinica) *javana orientalis* Rensch Zool. Jahrb. Syst., 61, p. 387, 1931 [handwritten] [label red]. Paratypes *Diplommatina javana orientalis*: 3 adults MHUB: Sunda-Expedition Rensch Fundort: [printed] Waë Renó (1000 m) W. Flores [handwritten] Datum: [printed]

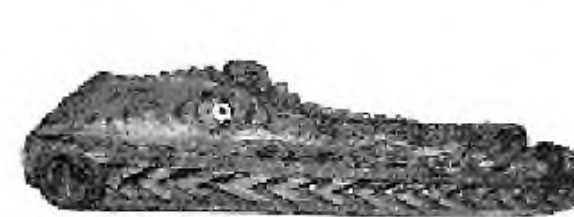
25.6.27 [handwritten] No: [printed] / Dipl. (Sinica) *floris* Paratypen. Rensch [handwritten] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica) *floris* Rensch Waë Renó, W. Flores 1000m 75430 Rensch [handwritten]; 3 adults, 1 juv. MHUB: Sunda-Expedition Rensch Fundort: [printed] Geli Moetoe (1300 m) Flores [handwritten] Datum: [printed] 21.7.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] Paratypen! *Diplommatina* (Sinica) *javana orientalis* Rensch * Geli Moetoe 1300m Flores 21.7.27 75432. Rensch [handwritten]; 3 adults MHUB: Sunda-Expedition Rensch Fundort: [printed] Batoeriti (800m), Bali [handwritten] Datum: [printed] 3.-4.8.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica) *javana orientalis* Rensch Batoeriti Bali 800 m 75433 Rensch [handwritten] [red circular label on the box].

Additional material 1 adult KGC: INDONESIA, Bali ls., Tamblingan, 08°15'10.8"S, 115°05'57.3"E, 1350 m, 03.IV.2011, primary lower montane rainforest, soil sample No 5, leg. A.Riedel.

References: Rensch B. (1931: 387), as *Diplommatina* (Sinica) *javana orientalis*; van Benthem Jutting (1948: 599-600), as *Diplommatina* (Sinica) *javana orientalis*; Vermeulen & Whitten (1998: 50, 138), new synonymy; Nurinsiyah & Hausdorf (2017: 211).

Measurements: Holotype *Diplommatina javana orientalis* H = 3.05 mm, D = 1.7 mm, HW = 1.45 mm, PD = 1.15 mm. Selected paratypes from Geli Moetoe: H = 2.9 mm, D = 1.6 mm, PD = 1.2 mm; H = 2.25 mm, D = 1.5 mm, PD = 1.2 mm.

Description: Shell is small, white to orange, sinistral, broadly conical with convex apex. Shell with 5½-5¾ convex whorls (according to Vermeulen & Whitten 1998 there are 4½-5¼ whorls in this species), the 1½ embryonic whorl is smooth. The suture is moderately deeply impressed. The ultimate whorl is narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short and shallow impression and denser and stronger sinuous ribbing pattern. The constriction is more or less centered in apertural view. The teleoconch is sculptured with fine, dense, slightly sinuous axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 19-20 ribs per 1 mm. Spiral striae very delicate, present on all whorls (holotype *Diplommatina javana orientalis*), or only on early whorls (paratypes *D. javana orientalis* and specimens from Bali). The aperture is not or barely tilted to the coiling axis, circular and has entire or parietally discontinued apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The



parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, broad in lateral view and consists of several distant lamellae. The inner peristome forms a continuous broad polished callus. The palatal margins of both peristomes are sinuous. In certain specimens the parietal side of the aperture expands up to the upper suture. There is one short parietalis. The columella is strongly obliquely twisted, forming a strong horizontal columellaris in its basal third. One distinct broad columellar denticle is directed downwards in specimens from Bali and Java, being smaller and not directed downwards in Flores specimens. Operculum is unknown.

Ecology: Specimens inhabit leaf litter, soil and lower vegetation in primary and secondary lowland to mid montane rainforests. It is observed on volcanic soils from lowlands up to 2700 m.

Distribution: Java, Bali; Lesser Sunda Islands: Flores Island.

Conservation status: Least Concern, LC. The current EOO is about 81000 km². The current AOO is about 40 km², however the maximum AOO is likely much higher. This species inhabits lowland to mid montane rainforests (possible because of habitat being degraded or unavailable at lower altitudes). No information is available on the population size and trend, but on Bali and Java this species is not uncommon. The main threat for this species is habitat alteration and decline in AOO. Since this species also known to occur in secondary and degraded rainforests, the population considered stable. The population on Java is severely fragmented (*D. javana* occurs in montane areas of Java with large gaps in-between (Nurinsiyah & Hausdorf 2017)), but not on Bali. Population fragmentation grade is unknown for Flores, since single historical locality is known from here. There are no less than five locations. Further research is required to assess the distribution of this species, its population size, trend and threats.

***Diplommatina* (s. l.) *jonabletti* sp. nov.** (Figs 14 & 113, plate 22 figs 8-17, map 13)

<http://zoobank.org/94BE653B-0162-4FB6-B8F5-5F531DF30E19>

Holotype BMNH: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 38.099'S, 120° 31.745'E, 2205 m, 09.III.2011, primary mid montane rainforest, soil sample No 3, leg. A.Riedel.

Paratypes 22 specimens: 4 adults & 1 subadult KGC: same label as holotype; 2 adults BMNH [syntypes of *D. floresiana* E.A. Smith, 1897]: Diplom. Floresiana Sm. S. Flores. 4000 ft. 97.8.3.75-4 [handwritten] / Floresiana, Smith I. Flores [handwritten] / PARALECTO-

TYPE [printed, label red, black frame] / *Diplommatina jonabletti* sp. nov. det. K.Greke, 2016 [printed]; 1 adult & 1 subadult NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 37'32.1"S, 120° 31'46.3"E, 1535 m, 08.III.2011, primary lower montane rainforest, soil sample No 1, leg. A.Riedel; 1 subadult NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 38.277'S, 120° 31.616'E, 2010 m, 10.III.2011, primary mid montane rainforest, soil sample No 5, leg. A.Riedel; 1 adult KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 37.714'S, 120° 31.509'E, 1850 m, 10.III.2011, primary mid montane rainforest, soil sample No 7, leg. A.Riedel; 1 adult & 1 subadult KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 37'71.4"S, 120° 31'50.9"E, 1850 m, 10.III.2011, primary mid montane rainforest, soil sample No 7B, leg. A.Riedel; 3 adults & 1 subadult NME, 2 adults KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 37'48.1"S, 120° 31'41"E, 1610 m, 10.III.2011, primary lower montane rainforest, soil sample No 10, leg. A.Riedel; 3 adults KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08° 37'38.6"S, 120° 31'15.6"E, 1575 m, 10.III.2011, primary lower montane rainforest, soil sample No 11, leg. A.Riedel.

Consider note by *D. floresiana* E.A. Smith, 1897.

Measurements: Holotype H = 2.7 mm, D = 1.65 mm, HW = 1.5 mm, PD = 1.2 mm. Selected paratypes from locus typicus: H = 2.85 mm, D = 1.7 mm, HW = 1.65 mm, PD = 1.25 mm; H = 2.8 mm, D = 1.65 mm, HW = 1.5 mm, PD = 1.2 mm; H = 2.85 mm, D = 1.7 mm, HW = 1.5 mm, PD = 1.2 mm. Paralectotypes of "*Diplommatina floresiana*" from southern Flores: H = 3.35 mm, D = 1.9 mm, HW = 1.9 mm, PD = 1.35 mm; H = 3.2 mm, D = 1.9 mm, HW = 1.7 mm, PD = 1.3 mm.

Description: Shell small, pale brown, sinistral, and broadly conical with a convex apex. Shell with 6 convex whorls, the 1¼-1½ embryonic whorl is microstriae. The suture is rather deeply impressed. The ultimate whorl is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adults. The constriction is poorly defined by a short and shallow impression and a short zone of denser placed axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, widely spaced ribs on early whorls but becomes dense on apertural side of the ultimate whorl. The axial ribs are slightly sinuous to nearly straight abruptly becoming denser around the constriction. The ribs are not synchronized with those on previous whorls and are straight or slightly oblique to the coiling axis. There are about 6-7 ribs per 1 mm on the penultimate whorl, becoming 2-3 times denser on the apertural surface of the ultimate whorl. The circular aperture is not or



is barely tilted against the coiling axis, and the peristome edges are connected or discontinued on the parietal side. The position of the aperture is more or less central against the coiling axis. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, provided with an obtuse angulation at palatal / parietal junction. The palatal and basal margins of both peristomes are sinuous. The palatal and basal margins of the outer peristome are reflexed. There is one short acute parietalis and one short transverse palatalis that is close to the upper margin of the last whorl (position of this tooth is almost central with regard to the parietal side of the peristome). One distinct narrow columellar denticle is directed downwards in fully grown specimens. The columella is shiny and thin, obliquely twisted and forming an acute oblique columellaris in its basal third. The operculum is translucent, irregularly circular and thin. Its corneous plate bears concentric lines.

Differential diagnosis: This species is similar to *Diplommatina floresiana* E.A. Smith, 1897 (Flores Island), but distinct in having a transverse palatalis whereas *D. floresiana* has a longitudinal palatalis. In addition *D. jonabletti* sp. nov. has denser axial ribs on the apertural side of the ultimate whorl. *D. javana* von Möllendorff, 1897 (islands of Bali, Flores, Java) is also similar, but differs in having a peristome with rounded margins that lacks angulations. *D. javana* also lacks a transverse palatalis in the upper part of the ultimate whorl that is present in *D. jonabletti* sp. nov.

Ecology: Specimens inhabit wet leaf litter and the underside of decaying wood in primary lower to mid montane rainforests, from altitudes of 1200-2205 m. Both recent and historical material comes from areas on volcanic soils.

Distribution: Lesser Sunda Islands: Flores Island. Conservation status: Endangered, EN B2ab(ii,iii). The current EOO is around 50 km². The maximum EOO estimated is about 15000 km² taking into account the area of Flores Island (13540 km²) and adjacent islands. The current AOO is about 16 km², however the AOO could be much higher since the species is undersampled, but the AOO is definitively below 500 km². No information is available on population size or population trends, but *Diplommatina jonabletti* sp. nov. seems rather common on Mt. Ranaka. This species inhabits moist litter of lower to mid montane rainforests, and is not found in arid and deforested lowlands. The population is not severely fragmented, but fragmentation is likely to increase. Main threats for this species are Habitat loss and alteration due con-

version of the rainforests into gardens as well as timber collecting and small-scale logging. Growing human population on Flores combined with more frequent and longer dry periods caused by global warming and El Niño weather patterns will likely have continued negative effect on the remaining natural rainforests of Flores. Between 2001 and 2014, Flores, its adjacent islands of Lembata, Adonara, Solor and Rinca lost almost 29000 ha of rainforest cover in the lowlands (Global Forest Watch 2016). Human population is not spreading significantly from the lowlands to the montane areas, but wet mountains are primarily threatened by expanding small-scale gardens and logging for construction purposes. These trends are likely to cause a continuing decline in the AOO and extent of the habitat. There are three known locations for *D. jonabletti* sp. nov. The human population is not encroaching on the habitat yet, but a continuing decline in the near future is projected based on the known trend of forest loss because of human activities and climate change. Additional research is required to determine its distribution, population size and population trends. The species is assessed as EN since AOO is between 16-500 km², and it is known from three locations.

***Diplommatina* (s. l.) *leucopsis* van Benthem Jutting, 1958** (Plate 24 figs 1-7, map 14)

Holotype NHMB: HOLOTYPUS [printed, label pink, glued on glass] / 6082 a Sumba, Baing [printed].

Additional material: 2 adults, 1 juv. NHMB: Sunda-Expedition Rensch Fundort: [printed] Waingapoe, Sumba Kambara-Genist [handwritten] Datum: [printed] 27.7.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Diplommatina* (Sinica ?) *fluminis* Paratypen! Rensch Waingapoe, Sumba Kambara Genist 75437 Rensch [handwritten] / *Diplommatina leucopsis* van Benthem Jutting, 1958 det. K. Greke, 2016 [printed] [these specimens were found among paratypes of *Diplommatina fluminis*].

References: van Benthem Jutting (1958b: 97-98, pl. 1 fig. 5); Monk et al. (1997: 395).

Measurements: Holotype H = 2.6 mm (adult shell is decollate), D = 1.6 mm, HW = 1.1 mm, PD = 1 mm. Selected adult specimens from type locality: H = 2.1 mm (adult shell is decollate), D = 1.3 mm, PD = 0.7 mm, H = 1.8 mm (adult shell is decollated), D = 0.9 mm, PD = 0.6 mm.

Description: Shell is very small, white to corneous, dextral, fusiform. Shell apex is convex in juvenile specimens. Shell with 6 strongly convex whorls (adult shell is decollate), there is 1 embryonic whorl. The suture is deeply impressed. The penultimate



whorl is bulbous. The ultimate whorl is constricted, much narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a distinct short impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, widely-spaced, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are straight to the coiling axis. There are about 10 ribs per 1 mm. The ribs are more widely-spaced on early whorls. Spiral striae are not visible at 80x magnification but is present according to the original description. The aperture is tilted about 10° against to the coiling axis and is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. A continuous callus is developed on the palatal, basal and columellar sides of the aperture. The peristome is double, consists of delicate close-standing lamellae in lateral view. Peristomal margins are not sinuous. One distinct columellar denticle, not directed downwards. No specimens were available to study the internal lamellae. The operculum is primitive - circular and translucent.

Ecology: According to the original description, this species occurs in wet rainforest leaf litter.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species is about 11000 km² taking into account the area of Sumba. This species is known from 3 specimens collected from two localities about 60 years ago and has not been collected again. The population size and trend are unknown. Between 2001 and 2014 Sumba has lost almost 10000 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.

***Diplommata* (s. l.) *lombockensis* E.A. Smith, 1898** (Plate 23 figs 19-22)

Syntypes 5 adults BMNH: *Diplommata Lombockensis*, Smith 1898, Type. Lombock [sic!] (W.Doherty) 98.7.20.1-5 [handwritten] / Lombockensis, Smith. Lombock I. [handwritten] / Type. [printed].

References: Smith E.A. (1898: 31, pl. 2 fig. 18), as *Diplommata Lombockensis*; Kobelt & von Möl-

lendorff (1898: 137), checklist, as *Diplommata* Subgen. *Eudiplommata* Kob. et Mölendorff. *lombockensis* [sic!]; Rensch B. (1931: 389), as *Diplommata* (*Pseudopalaina*) *lombockensis*.

Measurements: Selected syntype H = 3.3 mm, D = 1.9 mm, HW = 1.7 mm, PD = 1.4 mm.

Description: Shell is small, white with upper half pale orange, sinistral, broadly conical with convex apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microgranulate. The suture is deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is very narrowly open. The constriction is poorly defined by a short shallow impression and suture becoming deeper above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with very coarse widely-spaced straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are synchronized with those of the previous whorls. The ribs range from straight to slightly oblique with regard to the coiling axis. In fully grown specimens ribs becoming much higher (lamella-like) near the suture. There are about 5 ribs per 1 mm, the ribs becoming somewhat denser on the apertural side of the ultimate whorl. Spiral striae are not visible at 80x magnification. The aperture is tilted about 10-20° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The margin of the outer peristome is expanding beyond the inner one. The palatal margin of the outer peristome is slightly sinuous, the basal margin is reflexed. One inconspicuous columellar denticle, not directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: Lesser Sunda Islands: Lombok Island. Exact locality is unknown, therefore a distribution map is not given.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from the type series sampled from single locality about 100 years ago and has not been collected again. The population size, trend and threats remain unknown for *D. lombockensis*. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.



***Diplommatina* (s. l.) *lucifuga* van Benthem Jutting, 1958** (Plate 24 figs 8-13, map 14)

Holotype NHMB: Holotypus [handwritten] / *Diplommatina* Stal. 575 Holotypus *lucifuga* [handwritten] / 6080 a Sumba, Waikarudi [printed] / HOLOTYPUS [printed, label pink, glued on glass].

Paratypes 3 adults & 1 subadult NHMB: Paratypen [handwritten] / 1 St. Zool. Mus. Amsterdam [handwritten] / *Diplommatina lucifuga* n.sp. Paratypen [handwritten] / Naturhist. Museum Basel Coll. Dr. Bühler Dr. Sutter 1949 Waikarudi Sumba 575 [printed] / 6080 a Sumba, Waikarudi [printed] / PARATYPOIDE [printed, label light green, glued on glass].

References: van Benthem Jutting (1958b: 96, pl. 1 fig. 3); Monk et al. (1997: 395).

Measurements (all adult shells are decollate): Holotype H = 2.5 mm, D = 1.3 mm, HW = 1 mm, PD = 0.83 mm. Two selected adult paratypes: H = 2.4 mm, D = 1.2 mm, PD = 0.8 mm; H = 2.35 mm, D = 1.25 mm, PD = 0.8 mm

Description: Shell is very small, white, dextral, narrow fusiform. Shell with 6 strongly convex whorls (adult shell is decollate), number of embryonic whorls is unknown. The suture is deeply impressed. The penultimate whorl is bulbous. The ultimate whorl is strongly constricted, it is much narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is very poorly defined. The constriction is situated beyond the aperture in apertural view. The teleoconch is sculptured with very coarse, widely-spaced, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis. There are about 5 ribs per 0.5 mm, the ribs becoming twice denser on the apertural side of the ultimate whorl. Spiral striae are distinct and dense. The aperture is tilted about 10° to the coiling axis, it is circular and has entire apertural rim. The parietal margin of the peristome is attached to the ultimate whorl. The aperture is shifted right against the coiling axis in apertural view. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. The palatal margins of both peristomes are hardly sinuous. One small columellar denticle, not directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: According to the original description, this species occurs on the ground under decaying wood of wet *Areca* and *Coconut* palms stands.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from five specimens sampled from single locality about 70 years ago and has not been collected again. The population size, trend and threats are unknown. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.

***Diplommatina* (s. l.) *maibrat* sp. nov.** (Plate 24 figs 14-17, map 22)

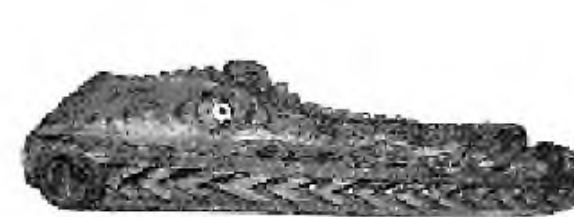
<http://zoobank.org/4E18F415-BF64-4018-A43E-625514E930DC>

Holotype NME: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. 23 km SE, Aqafu springs, 1°23'15S, 132°22'04"E, ~330-340 m, 04.IX.2015, primary lowland rainforest on limestone, near the springs, leg. D.Telnov.

Derivatio nominis: Named after Maibrat, local tribe and language of central part of Doberai Peninsula lowlands, the area where this species was first collected. Noun in apposition, invariable.

Measurements: Holotype H = 2.3 mm, D = 1.5 mm, HW = 1.6 mm, PD = 1.1 mm.

Description: Shell is small, yellow, sinistral, conical with pointed apex. Shell with 6 convex whorls, the 1¼ embryonic whorl is smooth. The suture is rather deeply impressed. The ultimate whorl is constricted, somewhat wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not defined on shell wall. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, dense, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 6 ribs per 0.5 mm. Spiral striae are very delicate, dense. The aperture is tilted about 10-15° to the coiling axis and is circular and has entire apertural rim. The position of the aperture is more or less central below the coiling axis. The parietal margin of the peristome is attached to the ultimate whorl in apertural view. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. The outer peristome with margins expanding and protruding on the palatal, basal and columellar sides (last one is less distinct). Both the palatal and basal margins of the outer peristome are distinctly sinuous. There is one distinct short longitudinal palatalis situated above the columellar side of the peristome. One small columellar den-



ticle, not directed downwards and poorly visible in the aperture by apertural view. Because only one specimen was available for study, I did not damage the shell to observe the internal lamellae which remain unknown for this species. The operculum also remains unknown.

Differential diagnosis: Most similar to *Diplommatina waigeoensis* sp. nov. from Waigeo Island (see description of this species below) but differs specifically in having much shorter longitudinal palatalis (it is about twice longer in *D. waigeoensis* sp. nov.), stronger spiral striae and one whorl shorter shell ($W = 7$ in *D. waigeoensis* sp. nov. compared with 6 whorls in *D. maibrat* sp. nov.).

Ecology: Specimen was found on underside of a fallen leaf in primary lowland rainforest on limestone soil (karst area) in a narrow and wet ravine.

Distribution: New Guinea: lowlands of Doberai Peninsula.

Conservation status: Data Deficient, DD. This species is currently known from a single specimen. Further research is required to assess the distribution of this species, its population size, trend and highlight threats.

***Diplommatina* (s. l.) *mertoni* C.R. Boettger, 1922**

(Figs 15, 129-131, plate 24 figs 18-23, map 15)

Holotype SMF: Senckenbg. Mus. [printed] 4686 [handwritten] Frankfurt a.M. [printed] Dipl. (*Diplommatina*) *mertoni* [underlined] C.BTTGR. TYPUS [printed, label red, glued on the main label] Batu Bandera, Maikor, Aru-Ins. H. Merton S. 9.IV.1908. [handwritten].

Paratypes 54 adults & 1 juv. SMF: Senckenbg. Mus. [printed] 4687 [handwritten] Frankfurt a.M. [printed] Dipl. (*Diplommatina*) *mertoni* [underlined] C.BTTGR. TYPUS [printed, glued on the main label] Batu Bandera, Maikor, Aru-Ins. H. Merton S. 9.IV.1908. [handwritten].

References: Boettger C.R. (1922: 359, 362, 401, pl. 22 figs 33-34), as *Diplommatina* (*Diplommatina*) *mertoni*; Zilch (1953: 21); van Benthem Jutting (1958a: 319), as *Diplommatina symmetrica*; van Benthem Jutting (1963: 711); Vermeulen (1996c: 112).

Measurements: Holotype $H = 4.2$ mm, $D = 2$ mm, $HW = 2.4$ mm, $PD = 1.8$ mm. Selected paratype specimens: $H = 4$ mm, $D = 2.05$ mm, $HW = 2$ mm, $PD = 1.6$ mm; $H = 3.9$ mm, $D = 2.1$ mm, $HW = 2.05$ mm, $PD = 1.6$ mm; $H = 3.65$ mm, $D = 1.95$ mm, $HW = 1.9$ mm, $PD = 1.7$ mm.

Description: Shell is large, pale brown to yellowish with darker embryonic whorls, dextral, elongate, and rather broadly conical with convex apex. Shell with $8\frac{1}{2}$ -9 convex whorls, the 1 embryonic whorl is densely microscopically pitted. The suture is moder-

ately deeply impressed. The ultimate whorl is rather bulbous, it is wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short zone of stronger developed sinuous axial ribs. The position of the constriction on same axis with the columellar side of the aperture. The teleoconch is sculptured with dense nearly straight axial ribs (ribs are sinuous on the apertural side of the ultimate whorl). There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are strongly oblique to the coiling axis. There are 10-11 ribs per 1 mm. In certain specimens the ribs becoming weaker below the suture of the penultimate whorl, disappear almost completely and reappear again on the suture. Spiral striae are distinct and rather widely-spaced (3 rows of spiral striae per 50 μ m measured on the ultimate whorl above the aperture at 200x magnification). The aperture is tilted about $40-45^\circ$ to the coiling axis, it is subquadrate or circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is indistinctly double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The margin of the inner peristome is much stronger and more prominent than less conspicuous outer peristome. The palatal margins of both peristomes are slightly sinuous. There is one long and acute parietalis. There are three palatalis. One long longitudinally-transverse palatalis is γ shaped and situated over the columellar side of the aperture. Another oblique transverse palatalis is situated at the upper margin of the ultimate whorl in central position with regard to the aperture. The third long transverse palatalis is flat and inconspicuous, situated in parallel the with γ shaped palatalis. One distinct broad columellar denticle, not directed downwards (cd may be reduced in certain specimens). The columella is shiny and thin, obliquely twisted, forming an acute and oblique columellaris in its basal third. The operculum is primitive - semicircular, partly translucent, with inconspicuous concentric lines.

Ecology: Unknown.

Distribution: Aru Islands: Maikoor Island. Records from Misool Island (van Benthem Jutting 1958a: 295, 319; 1963: 711) refer to *Diplommatina telnovi* sp. nov. (see description of this species below).

Conservation status: Data Deficient, DD. This species is known from the type series sampled more than 100 years ago and has not been collect-



ed again. The habitat, population size and threats are unknown for *D. mertoni*. Further research is required to assess the distribution of this species, its population size, trend and threats.

Remarks: According to the original description, the type series consist of 57 specimens. Of them, only 56 were located at SMF.

***Diplommatina* (s. l.) *moluccensis* sp. nov.** (Plate 25 figs 1-5, map 6)

<http://zoobank.org/6B46E6F4-DA0B-4898-B7E7-9220EE7AADBC>

Holotype NME: INDONESIA E, North Moluccas, Tidore Is., [outer slope of] caldera of Sabale volcano, 0°43'20"N, 127°26'16"E, 450-530 m, 29.VI.2013, secondary lowland rainforest, leaf litter, leg. K.Greke.

Paratypes 31 adults, 7 subadults, 7 juv.: 13 adults KGC, 16 adults, 7 subadults & 7 juv. NME: same label as holotype; 2 adults UF: UF 426296 Mollusca, Diplommatinidae 2-spec. Diplommatina Indonesia, Maluku Utara Province Ternate Island, 3 km SE of Togafo disturbed rainforest 0.8093° 127.2948° John Slapcinsky 29 Oct 2008, JDS-0946 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY.

Derivatio nominis: Toponymic. This species is named after its area of origin, the Moluccas or Maluku.

Measurements (all adult shells are decollate): Holotype H = 2.1 mm, D = 1.05 mm, HW = 0.85 mm, PD = 0.8 mm. Selected paratypes from Tidore Island: H = 2.2 mm, D = 1.15 mm, HW = 0.8 mm, PD = 0.8 mm; H = 2.2 mm, D = 1.1 mm, HW = 0.8 mm, PD = 0.8 mm; H = 2.1 mm, D = 1.1 mm, HW = 0.8 mm, PD = 0.75 mm; H = 2.1 mm, D = 1.15 mm, HW = 0.85 mm, PD = 0.85 mm; H = 2.2 mm, D = 1.1 mm, HW = 0.9 mm, PD = 0.8 mm; selected paratype from Ternate Island H = 2.2 mm, D = 1.15 mm, HW = 0.85 mm, PD = 0.8 mm.

Description: Shell very small, whitish, dextral, narrow fusiform. Shell apex is convex in juvenile specimens (when not decollate). Shell with 6-6¼ convex whorls (shell is decollate in adult specimens), the 1½ embryonic whorl is smooth. The suture is rather deeply impressed. The penultimate whorl is bulbous. The ultimate whorl is strongly constricted and distinctly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a distinct short impression. The constriction is situated ¼ whorl beyond the aperture. The teleoconch is sculptured with dense, straight axial ribs. The ribs becoming tilted in a direction opposite to the coiling axis in the upper parts near the suture on the last half whorl. There are no abrupt changes in the

ribbing pattern. The ribs are not synchronized with those of the previous whorls. The ribs range from straight to slightly oblique to the coiling axis. There are 8-9 ribs per 0.5 mm. Spiral striae are lacking in adult specimens at 80x magnification (juv. and subadult shells are clearly finely and densely spirally striate). The aperture is tilted about 10-20° to the coiling axis, is semicircular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is distinctly double, thin in lateral view. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The basal margin of the outer peristome is slightly reflexed. Two palatalis are present. There is one transverse palatalis situated entirely beyond the parietal / palatal junction of the peristome. There is one longitudinal oblique parietalis. The columella is shiny and thin, obliquely twisted, forming an acute and oblique columellaris in its basal third. One very long columellar denticle is directed downwards. The operculum is primitive - circular, corneous, and translucent.

Differential diagnosis: Most similar to *Diplommatina leucopsis* van Benthem Jutting, 1958 and *D. lucifuga* van Benthem Jutting, 1958 (both from Sumba Island), but differs specifically in slender shell, very long columellar denticle (cd is rather small in both *D. leucopsis* and *D. lucifuga*), absence of spiral striae in adult specimens (spiral striae are distinct in *D. lucifuga*), and in straight basal side of the peristome (basal side of the peristome is round in both *D. leucopsis* and *D. lucifuga*).

Ecology: Specimens were sampled from under of wet leaves from litter accumulated in a large ground cavity in secondary lowland rainforest (under shady and wet conditions) on slope of old overgrown caldera of the volcano (clay-like rainforest soil). Specimen from Ternate Island was sampled in a disturbed rainforest.

Distribution: North Moluccas: Ternate & Tidore. Conservation status: Endangered, EN B1ab(i-ii), B2ab(iii). Not enough data available to calculate current EOO; the current AOO is 8 km². This species is hitherto known from two small islands with active volcanoes as well as dense and growing human population. It is likely *Diplommatina moluccensis* sp. nov. also occurs on neighbouring islands (for example, Hiri, Moti and the western arms of Halma-hera). This species EOO and AOO estimated at least twice what is currently known, but definitively below 500 km² for AOO. I assume this species historically inhabited primary rainforests, but is now limited to



secondary forests (primary rainforest has not existed on either islands for more than 100 years). The main threat is habitat loss as remaining secondary rainforest is cleared due to the expansion of human settlements (on Ternate island), wood consumption for various purposes (on both Ternate and Tidore islands) and conversion of rainforest into gardens and plantations (on both Ternate and Tidore). Considering the size of the EOO and its location on active volcanoes (patches of rainforest only present on volcanic slopes above 400 m and in old calderas on Ternate and Tidore), a very large volcanic eruption on one of the islands may in theory destroy a half of the current EOO (but considering the geological past of both Ternate and Tidore, such a super-eruption is very unlikely). This species is known from two locations considering the main threat. The population is not severely fragmented as the minimum distance between the islands is just 2.2 km. Despite the distance being so short, gene flow between subpopulations considered very low due to absence of species' habitat (forests) along the coast. Snails can potentially travel on floating material between two islands, but absence of suitable habitats along the coastline makes recolonization very difficult. Transportation by birds or human (with substrate or plants) from one island to another is the most realistic scenario for gene exchange and re-colonization. Continuing decline is observed in extent and quality of habitat. Remaining lowland rainforests on Ternate and Tidore to be protected, green corridors between remaining forest patches to be maintained. Further search for *D. moluccensis* localities is required on neighbouring Hiri, Mare, Moti islands and on western Halmahera.

***Diplommatina* (s. l.) *patani* sp. nov.** (Fig. 16, plate 25 figs 10-14, map 5)

<http://zoobank.org/499BCB39-7C0F-459D-8045-84FF2F5DCDEE>

Holotype NME: INDONESIA E, North Moluccas, Halmahera SE, Patani W, between the jetty & Patani, 0°18'10"N, 128°39'38"E, 15-50 m, 10.VII.2013, secondary lowland rainforest, leaf litter, leg. K.Greke.

Paratypes 15 adults & 3 juv. NME, 11 adults KGC: same label as holotype.

Derivatio nominis: Named after Patani, local language and tribe in SE arm of Halmahera. Noun in apposition, invariable.

Measurements: Holotype H = 2.35 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.9 mm. Selected paratype specimens: H = 2.2 mm, D = 1.1 mm, HW = 1 mm, PD = 0.8 mm; H = 2.2 mm, D = 1.1 mm, HW =

0.85 mm, PD = 0.8 mm; H = 2.2 mm, D = 1.05 mm, HW = 0.9 mm, PD = 0.85 mm; H = 2.1 mm, D = 1 mm, HW = 0.9 mm, PD = 0.8 mm.

Description: Shell is very small, white to pale brown, dextral, narrow and high conical with convex apex. Shell with 7 convex whorls, the 1½ embryonic whorl is smooth. The suture is moderately deeply impressed. The ultimate whorl is almost as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is very poorly defined by an inconspicuous shallow impression. The position of the constriction with the parietal wall of the aperture. The teleoconch is sculptured with coarse, dense, wavy sinuous axial ribs. The ribs becoming high, lamella-like and are slightly bending counter-clockwise on the periphery of each whorl. The ribs are also slightly bending counter-clockwise near and in the suture. The ribs are sinuous below the suture becoming weaker at the point of inflection and reappear again on the suture. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis. There are 5-9 ribs per 0.5 mm. In certain specimens ribs becoming denser on the apertural side of the ultimate whorl. Spiral striae are distinct and dense. The aperture is tilted about 20° to the coiling axis and is circular to slightly ovoid and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly double, consists of several delicate dense lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The palatal and the basal margins of both peristomes are sinuous. Both the inner and outer peristomes provided with an obtuse angulation at the basal / columellar junction. There is one obtuse parietalis. There is one short palatalis situated over the columellar side of the peristome. The columella is shiny and thin, obliquely twisted, forming an acute oblique median columellaris. One small columellar denticle, not directed downwards. The operculum is primitive - circular, translucent and bears concentric lines.

Differential diagnosis: Most similar to *Diplommatina radiiformis* Preston, 1913 (North Moluccas). In *D. patani* sp. nov. the palatalis is comparatively shorter and situated lower down on the wall of the ultimate whorl (pt is closer to the columellar side of the peristome), but in *D. radiiformis* this pt is much longer and situated closer to the upper margin of the ultimate whorl, distant from the columellar side of the peristome. *D. patani* sp. nov. also



differs in higher and lamella-like ribs, especially on the periphery of whorls which is not the case in *D. radiiformis*.

Ecology: This species found in disturbed secondary lowland rainforest on limestone soil, but presumably also inhabits primary lowland rainforests. Specimens observed on undersides of leaves accumulating at base of limestone rock formations and at buttress roots of large trees.

Distribution: North Moluccas: south-eastern arm of Halmahera Island.

Conservation status: Data Deficient, DD. *Diplommatina patani* sp. nov. is currently known from single locality, therefore current EOO cannot be calculated. The maximum EOO estimated about 1500 km² taking into account the distribution of limestone soils in south-eastern Halmahera. The current AOO is 4 km². The maximum AOO is likely higher but definitively below 500 km². The population size and trend are unknown, but this species is locally abundant. Habitat loss (lowland rainforests on limestone) considered the main threat for this species. Forested area of Halmahera's south-eastern arm is decreasing consequently; between 2001 and 2014 about 11000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Taking into account constantly growing human population on the North Moluccas and presence of large functioning nickel mine in Central Halmahera (which is attracting workers from other regions of Indonesia), this trend is likely to continue. Further research is required to assess the distribution of *D. patani* sp. nov., its population size, trend and threats.

***Diplommatina* (s. l.) *radiiformis* Preston, 1913**

(Figs 17-18, 111, plate 25 figs 15-24, map 5)

Holotype NHMB: *Diplommatina radiiformis* Preston Type Isd. of Beilan Beilan Dutch E. Indies: [original correction] Moluccas. 1914.1.7.463 25-15 [handwritten] / Type. [printed] / *radiiformis* Preston Moluccas [handwritten].

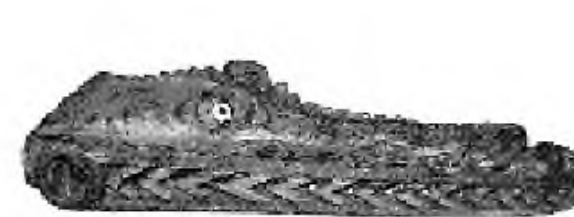
Additional material: 1 subadult LKCNHM: Indonesia: Maluku, Halmahera, N of Weda. leg. Tony Whitten, 11 January 2013; 3 adults KGC & 2 adults NME: INDONESIA E, North Moluccas, Tidore Is., [outer slope of] caldera of Sabale volcano, 0°43'20"N, 127°26'16"E, 450-530 m, 29.VI.2013, secondary lowland rainforest, leaf litter, leg. K.Greke; 2 adults KGC: INDONESIA E, North Moluccas, Halmahera N, Galela area, Mt. Ngededo Ma Girapang at Roko vill., 1°50'07"N, 127°43'17"E, 230 m, 02.VII.2013, primary & secondary lowland rainforest, leaf litter, leg. K.Greke.

References: Preston (1913: 437).

Measurements: Holotype H = 2.4 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.85 mm. Specimens from Tidore Island: H = 2.2 mm, D = 1 mm, HW = 1 mm, PD = 0.8 mm; H = 2.15 mm, D = 1.1 mm, HW = 1 mm, PD = 0.8 mm; H = 2.35 mm, D = 1.2 mm, HW = 1.05 mm, PD = 0.9 mm.

Description: Shell is very small, white with pale brown protoconch, dextral, narrow and high conical with convex apex. Shell with 7 convex whorls, the 1½ embryonic whorl is densely microscopically pitted. The last half of the protoconch is especially densely pitted and the pits are arranged in axial rows. The suture is moderately deeply impressed. The penultimate whorl is slightly bulbous. The ultimate whorl is somewhat constricted, it is slightly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short and shallow impression. The constriction is situated on same axis with the palatal side of the aperture. The teleoconch is sculptured with coarse, dense, irregularly sinuous axial ribs. In fully grown specimens the ribs becoming high, lamella-like and are slightly bending counter-clockwise on the upper part of each whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis, but slightly oblique on last two whorls. There are 5-6 ribs per 0.5 mm, the ribs becoming denser on the apertural side of the ultimate whorl. Spiral striae are delicate but distinct and dense. The aperture is tilted about 15-20° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly double, consists of a few delicate lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not or slightly sinuous. The palatal margin of the outer peristome is sinuous. There is one long longitudinal palatalis in the upper part of the ultimate whorl, close to the suture and situated over the columellar side of the aperture. The columella is shiny, obliquely twisted, forming an acute and oblique columellaris in its basal third. One small pointed columellar denticle, not directed downwards. The operculum is primitive - translucent, circular and bears concentric lines.

Ecology: On Tidore specimens were sampled from under of wet leaves in leaf litter accumulated in a large depression in the ground, in secondary lowland rainforest (under shady and wet conditions) on slope of old, overgrown caldera of the volcano (clay-



like rainforest soil). On Halmahera, specimens were found on undersides of wet leaves in litter of primary lowland rainforest (already being disturbed) on a limestone slope.

Distribution: North Moluccas: Belangbelang Island of Obi Islands group, Tidore Island, Halmahera Island.

Conservation status: Least Concern, LC. The current EOO is 3970 km². The maximum EOO estimated 40000 km² and also includes Ternate, Bacan, Obira and southern arm of Halmahera. There are no recent records from Obi Islands for this species. However, primary rainforest habitats are still available in this part of North Moluccas. The current AOO is 12 km², the maximum AOO is likely much higher and is predicted between 500 and 1000 km² considering available habitat. This species limited to secondary forests on Tidore (primary rainforest has not existed here for more than 100 years). On Halmahera it occurs in primary rainforests on limestone soil. There are at least three locations known for this species. The population size and trend are unknown. The population is severely fragmented as is presently known. This species is known from several islands with active volcanoes. Both Tidore and Halmahera have constantly growing human population, similarly to other North Moluccan islands. Habitat (lowland rainforests) loss and altering considered the main threats, in particular due to the expansion of human settlements, wood consumption for various purposes and conversion of remaining rainforest into gardens and plantations. Considering large distribution area of *D. radiiformis*, habitat decline is unlikely to affect all subpopulations at same time. Further research is required to assess the distribution, population size and trend for *D. radiiformis*.

***Diplommatina* (s. l.) *slapcinskyi* sp. nov.** (Fig. 19, plate 21 figs 14-17, map 6)

<http://zoobank.org/0613C0B5-37FA-4168-A35E-5887688BB26C>

Holotype UF (No 508076): UF 426407 Mollusca, Diplommatinidae 5-spec. *Diplommatina* sp. 3 Indonesia, Maluku Utara Province Obi Island, border of garden and rainforest 2.3 km N of Woi gardens and rainforest 150 meters -1.7045° 127.6067° John Slapcinsky 26 Oct 2008, JDS-0942 dry FLORIDA MUSEUM OF NATURAL HISTORY.

Paratypes 26 specimens: 4 UF: same label as holotype; 14 adults, 1 subadult, 2 juv. UF & 6 adults KGC: UF 426265 Mollusca, Diplommatinidae 15-spec. *Diplommatina* Indonesia, Maluku Utara Province Obi Island, border of garden and rainforest 2.3 km N of Woi gardens and rainforest 150 meters -1.7045° 127.6067°

John Slapcinsky 26 Oct 2008, JDS-0942 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY.

Derivatio nominis: Patronymic. This species is named after the first collector, famous malacologist and specialist on Papuan malacofauna, my colleague John Slapcinsky (UF).

Measurements: Holotype H = 2.7 mm, D = 1.15 mm, HW = 1 mm, PD = 0.95 mm. Selected paratypes: H = 2.8 mm, D = 1.35 mm, HW = 1.2 mm, PD = 1.1 mm; H = 2.7 mm, D = 1.3 mm, HW = 1.15 mm, PD = 1.1 mm; H = 2.7 mm, D = 1.4 mm, HW = 1.15 mm, PD = 1 mm; H = 2.7 mm, D = 1.3 mm, HW = 1.2 mm, PD = 1 mm; H = 2.7 mm, D = 1.35 mm, HW = 1.1 mm, PD = 1.1 mm.

Description: Shell is very small, white, dextral, narrow and high conical with a convex apex. Shell with 8 convex whorls, the 1½ embryonic whorl is smooth. The suture is deeply impressed. The ultimate whorl is only slightly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adults. The constriction is poorly defined by a short shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, widely-spaced, wavy curved axial ribs like flat lamellae. The highest ribs are on the 6-7 whorls. There are no abrupt changes in ribbing pattern. The ribs are synchronized with those of previous whorls and are straight or slightly oblique to the coiling axis. There are 3-4 ribs per 0.5 mm. Spiral striae are distinct and dense. The aperture is tilted about 20° from the coiling axis, is irregularly oval or rhomboid and has entire apertural rim. The parietal margin of the peristome is attached to the ultimate whorl. The aperture is slightly shifted right against the coiling axis in apertural view. The peristome is double. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The palatal margin of the outer peristome is slightly sinuous. There is one acute parietalis and one long longitudinal palatalis near the columellar side of the aperture. The columella is shiny, obliquely twisted, forming a very strong acute and oblique columellaris in its basal third. One small but distinct columellar denticle, not directed downwards. The operculum is primitive - circular and transparent, without concentric ridges.

Differential diagnosis: This species is peculiar due to the presence of high and wavy curved, lamella-like axial ribs.

Ecology: This species inhabits primary and secondary lowland rainforests, as well as gardens and occurs in leaf litter.



Distribution: Southernmost North Moluccas: Obi Islands, Obira Island.

Conservation status: Data Deficient, DD. This species is known from a single locality. Not enough data available to calculate current EOO. The maximum EOO is below 5000 km² taking into account the area of Obi Islands. The current AOO is 4 km². The maximum AOO is likely much higher, but definitively less than 500 km². The population size and population trends are unknown. The population is not severely fragmented. Currently there is one location but more than 5 locations are considered with regard to the maximum EOO. Habitat loss and decline in habitat quality caused by logging, mining (on Obira Island), conversion of the forest into gardens and plantations, and expansion of settlements in lowland areas considered the main threats. Between 2001 and 2014 the forested part of the maximum EOO has decreased by over 14000 ha (calculated for canopy density over 25% according the Global Forest Watch (2016)). Considering human population growth in the area, this trend is likely to continue. Additional research is required in order to clarify species distribution, population size, trends and highlight threats.

***Diplommatina* (s. l.) *smithi* Kobelt et von Möllendorff, 1898** (Plate 25 figs 6-9, map 22)

= *Diplommatina papuana* E.A. Smith, 1897

Lectotype BMNH [herewith designated]: *Diplom. papuana* Smith Kapaur New Guinea 97-7-30.57-8 [handwritten] / *papuana*, Smith Kapaur New Guinea [handwritten].

Paralectotype 1 adult BMNH [herewith designated]: same labels as lectotype.

Lectotype designation: Lectotype is selected from two syntypes with identical labels.

References: Smith E.A. (1897b: 418, pl. 9 figs 28-29), as *Diplommatina papuana* nec *D. papuana* Tapparone-Canefri, 1883; Kobelt & von Möllendorff (1898: 142), as *Diplommatina* Subgen. *Sinica* Mlldff. *smithi* Kob. et. Mlldff. nec *D. papuana* Sm.[ith] Tap.[parone] Can.[efri, 1883]; Kobelt (1902: 473); van Benthem Jutting (1963: 712).

Measurements: Lectotype H = 3.1 mm, D = 1.9 mm, HW = 2 mm, PD = 1.5 mm.

Description: Shell is small, creamy with brown embryonic whorls, sinistral, short, conical with convex apex. Shell with 6 convex whorls, the 1^{1/4} embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is rather bulbous and wider than the penultimate whorl in apertural view. The umbilicus is closed in

adult. The constriction is poorly defined by axial ribs becoming sinuous in this area. The constriction is situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with coarse, dense, nearly straight axial ribs (ribs are slightly sinuous on the apertural side of the ultimate whorl). There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9 ribs per 1 mm. Spiral striae are distinct, rather strong and widely-spaced. The aperture is tilted about 25-30° to the coiling axis, is oval or semicircular with apertural rim broadly discontinued parietally. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The parietal side of the peristome is pressed against the parietal wall. The inner peristome forms a continuous polished callus on the palatal and the basal sides. Two obtuse protrudings developed on the columellar and on the basal margins of the outer peristome. The margin of the outer peristome expands beyond the inner peristome near the palatal / parietal junction. It is unclear if there is any parietalis or not (not visible through the shell wall in historical specimens). There is one transverse palatalis situated on the parietal wall over the peristome. Another long longitudinal palatalis situated over the columellar side of the peristome. One small and inconspicuous columellar denticle, not directed downwards. Internal lamellae were not studied. Operculum is unknown. Ecology: Unknown.

Distribution: New Guinea: Onin Peninsula. Record from northern New Guinea by Bavay (1908) is misidentification of *Palaina consobrina* van Benthem Jutting, 1963.

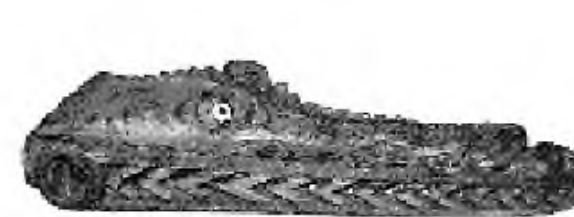
Conservation status: Data Deficient, DD. This species is known from the type series sampled more than 100 years ago and has not been reported again. Additional research is required to clarify status of this species in the wild, assess its distribution, population size, trends and highlight threats.

***Diplommatina* (s. l.) *symmetrica* Hedley, 1891** (Figs 20 & 136, plate 26 figs 1-5, map 25)

Lectotype BMNH [herewith designated]: *Diplommatina symmetrica* Hedley Cotype Basilaki, B.N.Guinea 9.2.2.4-100-104, C.Hedley Esq. [handwritten].

Paralectotypes 6 adults BMNH: same label as lectotype.

Lectotype designation: Lectotype is selected



from series of 7 syntypes, all with the same label.

Note: Iredale (1941: 62) established a new genus *Euadnita* with the type species *Diplommatina symmetrica*. Here I follow Egorov (2013) and consider *Euadnita* a junior synonym of *Diplommatina*.

References: Hedley (1891: 107, pl. 12 fig. 39); Kobelt & von Möllendorff (1898: 138), as *Diplommatina* Subgen. *Eudiplommatina* Kob. et Mlldff. *symmetrica*; Kobelt (1902: 447), as *D. (D.) symmetrica*; Soós (1911: 349); Leschke (1912a: 145); Iredale (1941: 63), as *Euadnita symmetrica*.

Measurements: Lectotype H = 3.4 mm, D = 1.6 mm, HW = 1.7 mm, PD = 1.3 mm. Selected paralectotypic specimens: H = 3.55 mm, D = 1.6 mm, HW = 1.7 mm, PD = 1.4 mm; H = 3.5 mm, D = 1.55 mm, HW = 1.7 mm, PD = 1.3 mm.

Description: Shell large, white translucent, dextral, narrowly conical with convex apex. Shell with $7\frac{1}{2}$ convex whorls, the $1\frac{1}{2}$ embryonic whorl is densely microscopically pitted. The suture is rather deeply impressed. The penultimate whorl is not bulbous, as wide as the ultimate whorl in apertural view. The constriction is poorly defined by axial ribs becoming denser and stronger sinuous. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, very widely-spaced straight axial ribs. The ribs are incomplete, not reaching the upper suture on all whorls (except the ultimate whorl where the ribs are complete). There are no abrupt changes in the ribbing pattern but the ribs are more widely-spaced on early teleoconch whorls than on the pen- and ultimate whorls. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 5-6 ribs per 1 mm. Spiral striae are delicate and dense (3 rows of spiral striae per 30 μ m measured on the ultimate whorl above the aperture by 300x magnification). The aperture is tilted about 30-35° to the coiling axis, is oval or semicircular has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. Peristomal margins are not sinuous. There is one long and acute parietalis. There is one long longitudinally-transverse γ shaped palatalis situated over the columellar side of the peristome. The columella is smooth, obliquely twisted, forming an oblique columellaris in basal third. The columellar denticle inconspicuous, not directed downwards. The operculum is primitive - circular, not transparent and without concentric lines or ridges.

Ecology: Specimens were sampled from decaying

leaves of *Pandanus* sp. on a steep hill.

Distribution: Louisiade Islands. Record from northern New Guinea (Soós 1911) is very doubtful (this material was not available for my study since Soós's collection was lost in the fire at the Hungarian Natural History Museum). Records from Onin Peninsula of New Guinea (Smith 1897b: 418, pl. 9 fig. 27) and Misool Island (van Benthem Jutting 1958a: 295, 319; 1963: 711) are based on misidentified specimens of *D. telnovi* sp. nov. (see description of this species below).

Conservation status: Data Deficient, DD. This species is known from historical specimens collected more than 100 years ago from one locality. Further research is required in order to clarify species' status in the wild, assess its distribution, population size, trends and highlight threats.

***Diplommatina* (s. l.) *telnovi* sp. nov.** (Figs 21, 132-135, plate 26 figs 6-21, map 22)

<http://zoobank.org/AB75DD64-3232-416A-911B-E37A6A6D2496>

Holotype NME: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. ~15.5-14 km N, 1°08'04"S, 132°10'59"E to 1°09'29"S, 132°11'30"E, ~275-250 m, 02.IX.2015, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 25 specimens: 2 adults NME, 2 KGC, 1 juv. KGC: same label as holotype; 2 adults NME, 3 KGC: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. 27 km SE, Uter lakeside, 1°26'03"S, 132°23'09"E, ~185 m, 04.IX.2015, primary lowland rainforest on limestone, base of limestone cliff, leg. D.Telnov; 2 adults KGC: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. 23 km SE, Aqafu springs, 1°23'15"S, 132°22'04"E, ~330-340 m, 04.IX.2015, primary lowland rainforest on limestone, near the springs, leg. D.Telnov; 6 adults NME, 5 adults & 1 subadult KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 1 adult & 1 subadult KGC: INDONESIA E, West PAPUA, Onin Peninsula, Fak-Fak 10 km E, 2°56'32"S, 132°23'01"E, Sakarteman vill. 1-4 km W, River Sakarteman valley, 350-450 m, 26.IX.2010, primary lowland rainforest on limestone, leg. K.Greke.

Derivatio nominis: Patronymic. This species is named after its collector, famous entomologist Dr. Dmitry Telnov (The Entomological Society of Latvia, Rīga).

References: Smith E.A. (1897b: 418, pl. 9 fig. 27), as *Diplommatina symmetrica*; van Benthem Jutting (1958a: 295, 319), as *Diplommatina symmetrica*; van Benthem Jutting (1963: 711), as *Diplomma-*



tina symmetrica.
Measurements: Holotype H = 3.4 mm, D = 1.9 mm, HW = 1.9 mm, PD = 1.55 mm. Selected paratype specimen from locus typicus: H = 3.3 mm, D = 1.75 mm, PD = 1.5 mm. Selected paratype specimens from Uter lake env.: H = 3.7 mm, D = 2 mm, HW = 2 mm, PD = 1.6 mm; H = 3.45 mm, D = 1.4 mm, PD = 1.5 mm; H = 3.35 mm, D = 1.9 mm, PD = 1.3 mm. Selected paratype specimens from Misool: H = 3.8 mm, D = 2 mm, PD = 1.6 mm; H = 3.55 mm, D = 2 mm, PD = 1.5 mm. Selected paratype specimens from Onin Peninsula: H = 3.6 mm, D = 2 mm, HW = 1.8 mm, PD = 1.5 mm.
Description: Shell is large, reddish to pale brown with bright orange embryonic whorls in adult (whitish to yellowish when juvenile), dextral, elongate, and rather broadly conical with convex apex. Shell with 7¾ convex whorls, the 1½-2 embryonic whorls are densely microscopically pitted. The suture is rather deeply impressed. The ultimate whorl rather bulbous, it is wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by axial ribs becoming denser and stronger sinuous. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, dense, sinuous axial ribs (the ribs are humped on the ultimate whorl in apertural view). The ribs are C-like sinuous below the suture, becoming weaker at the point of inflection resulting in a spiral groove below the suture (perfectly visible in subadult specimens in top view, Plate 26 fig. 21). There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 8-10 ribs per 1 mm. Spiral striae are very delicate, dense (5 rows of spiral

striae per 50 µm measured on the ultimate whorl above the aperture by 200x magnification). The aperture is tilted about 25-35° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is distinctly double, thin in lateral view. The inner peristome forms a continuous polished callus on the palatal, basal and columellar margins. Both the inner and outer peristomes are more or less equally strong, with a few delicate lamellae in-between. In certain specimens the palatal margin of the outer peristome is slightly sinuous. There is one high and acute parietalis. There are three palatalis. One long longitudinally-transverse 7 shaped palatalis situated above the columellar side of the peristome. Another obliquely transverse palatalis situated near the suture / upper side of the ultimate whorl in central position regarding to the aperture. The third long transverse palatalis is inconspicuous and is running parallel with 7 shaped one. The columella is shiny, obliquely twisted, forming a strong acute oblique median columellaris. One distinct columellar denticle, not directed downwards. The operculum is primitive - semicircular, transparent, with few concentric lines.
Differential diagnosis: This species is extremely similar to *Diplommatina mertoni* C.R. Boettger, 1922 (Aru Islands) and *D. symmetrica* Hedley, 1891 (Louisiade Islands). Consider table 8 for diagnosis of these species. Thus, the characters slightly vary (comparative specimens are mandatory for proper identification). In general, genetic analysis is required to highlight phylogenetic relationships between these three species.

Table 8. Papuan species of *Diplommatina* s. l. similar to *D. telnovi* sp. nov. and their distinctive characters.

Species	Character	Character in <i>D. telnovi</i> sp. nov.
<i>Diplommatina mertoni</i>	shell generally less slender and larger, H = 3.65-4.2 mm, peristome is indistinctly double with the outer peristome less strong than the inner one, 3 rows of spiral striae per 50 µm (measured on the ultimate whorl above the aperture), 10-11 axial ribs per 1 mm	shell generally slender and smaller, H = 3.6-3.8 mm, peristome is distinctly double with both the inner and outer peristomes equally strong and prominent, 5 rows of spiral striae per 50 µm (measured on the ultimate whorl above the aperture), 8-10 axial ribs per 1 mm
<i>D. symmetrica</i>	shell generally slender, 5-6 axial ribs per 1 mm, axial ribs less conspicuously curved in their upper parts	shell generally less slender, 8-10 axial ribs per 1 mm, axial ribs C-like curved in their upper parts

Phylogeny: According results of COI analysis (specimens sampled ~15 km N of Ayamaru vill.) this species represents Webster’s et al. (2012) clade E and demonstrates far relationship with Bornean *D. gomantongensis* E.A. Smith, 1894 and North Mo-

lucan *Diancta constricta* (Martens, 1864) (consider chapter “Phylogeny”).
Ecology: This species occurs in primary lowland rainforests on limestone soils or on dolomite. Specimens were sampled from underside of large fallen



leaves in wet leaf litter, also at base of limestone rocks and near large standing trees.

Distribution: New Guinea: lowlands of Doberai Peninsula & Onin Peninsula; Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. The current EOO is 28000 km², however the maximum EOO estimated over 60000 km². The current AOO is 28 km². The maximum AOO is likely at least 500 km² considering available habitat. The population size is unknown, but this species is not uncommon. There are at least 5 locations considering the presently known distribution and with regard to the main threat. Habitat loss and alteration qualify as the main threats. Both Misool Island and Onin Peninsula of New Guinea not suffered from deforestation and primary rainforest loss (Global Forest Watch 2016). Southern lowlands of Doberai Peninsula are affected by deforestation caused primarily by oil-drilling industry, strong development due to the Papuan Autonomy (investments) and growing human population. Still, there are vast areas of untouched forests available for *D. telnovi* sp. nov. in this area. I cannot predict significant decline in the EOO or AOO for this species within the next 10 years.

***Diplommatina* (s. l.) *timorensis* sp. nov.** (Fig. 22, plate 25 figs 25-29, map 12)

<http://zoobank.org/3DDDF152-329A-444A-95B8-54CB79CE812B>

Holotype NME: INDONESIA E, Timor W, Fatumnasi vill. 3 km NNE, 9°37'28"S, 124°14'19"E, 1620-1630 m, 05.IV.2016, base of limestone outcrop, leaf litter, leg. L.Wagner.

Derivatio nominis: Toponymic. This species is named after its area of origin, Timor Island.

Measurements: Holotype (adult shell is decollate) H = 2 mm, D = 0.95 mm, HW = 0.9 mm, PD = 0.7 mm.

Description: Shell is small, yellowish, dextral, narrow and high conical. Shell with 4½ convex whorls (adult shell is decollate), number of embryonic whorls is unknown. The suture is rather deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is narrowly open, perspective. The constriction is poorly defined by a short and shallow impression. The constriction is situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with fine, dense, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of

the previous whorls and are slightly oblique to the coiling axis. There are about 12-13 ribs per 0.5 mm. Spiral striae are delicate and dense. The aperture is not or slightly tilted to the coiling axis, is oval or subquadrate and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple and forms a continuous polished callus. The parietal margin is attached to the ultimate whorl. The palatal margin of the peristome is slightly sinuous. There is one very high and acute parietalis. The columella is shiny, obliquely twisted, forming an acute oblique median columellaris. One very inconspicuous flat columellar denticle, not directed downwards and not visible in the aperture in apertural view. Operculum is unknown.

Differential diagnosis: This new species is similar to several *Diplommatina* with fusiform and decollate shells from Lesser Sunda Islands (*D. floris* B. Rensch, 1931, *D. fluminis* B. Rensch, 1931, *D. leucopsis* van Benthem Jutting, 1958b, *D. lucifuga* van Benthem Jutting, 1958b) and North Moluccas (*D. moluccensis* sp. nov.; see description of this species above). *D. timorensis* sp. nov. is conspicuous primarily in having open umbilicus, simple peristome (peristome is clearly double in *D. floris*, *D. leucopsis*, *D. lucifuga*, *D. moluccensis* sp. nov.), very flat columellar denticle which is not visible in apertural view (cd is distinct in *D. leucopsis* and *D. moluccensis* sp. nov.) and in both the ultimate and penultimate whorls being of equal width (the ultimate whorl is distinctly narrower than the penultimate whorl in apertural view in *D. fluminis* and *D. leucopsis*).

Ecology: This species was found in leaf litter of lower montane rainforest at base of the limestone outcrop at ~1600 m altitude.

Distribution: Lesser Sunda Islands: Timor Island. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated less than 20000 km² taking into account the area of Timor and the distribution of rainforests on this predominantly arid island. The population size and trend as well as threats are unknown for this species. Further research is required to clarify distribution, population size, trends and highlight threats for *D. timorensis* sp. nov.

***Diplommatina* (s. l.) *torquilla* van Benthem Jutting, 1958** (Plate 27 figs 1-3, map 12)

Holotype NHMB: Holotypus [handwritten] / *Diplommatina* Stal. 373 Holotypus *torquilla* [handwritten] / 6081 a Sumba, Kodi [printed] / HOLOTYPUS [printed, label pink,



glued on glass].

Paratypes 3 adults & 2 juv. NHMB: Paratypen [handwritten] / Diplommatina torquilla n. sp. Paratypen [handwritten] / Naturhist. Museum Basel Coll. Dr. Bühler Dr. Sutter 1949 Kodi Sumba 373 [printed] / 6081 b Sumba, Kodi [printed] / PARATYPOIDE [printed, label light green, glued on glass] [two adults are badly broken].

References: van Benthem Jutting (1958b: 97, pl. 1 fig. 4); Monk et al. (1997: 395).

Measurements: Holotype (adult shell is decollate) H = 2.5 mm, D = 1.3 mm, HW = 1.1 mm, PD = 0.83 mm. Selected paratypic specimens (adult shells are decollate) H = 2.4 mm, D = 1.2 mm, PD = 0.8 mm; H = 2.35 mm, D = 1.25 mm, PD = 0.8 mm. Description: Shell is very small, white, dextral, narrow and high conical. Shell with 5½-6 convex whorls (adult shell is decollated), number of embryonic whorls is unknown. The suture is deeply impressed. The penultimate whorl is bulbous. The ultimate whorl is constricted, distinctly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short and shallow impression. The constriction situated slightly beyond the aperture in apertural view. The teleoconch is sculptured with coarse, very widely-spaced, straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis. There are about 4 ribs per 0.5 mm, the ribs becoming denser on the apertural side of the ultimate whorl. Spiral striae are distinct and dense. The aperture is tilted about 10-15° to the coiling axis, is oval and has entire apertural rim. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The palatal margins of both the inner and outer peristomes are sinuous. The inner peristome forms a continuous polished callus. One small but distinct columellar denticle, not directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: Lesser Sunda Islands: Sumba Island.

Conservation status: Data Deficient, DD. *Diplommatina torquilla* is known from type series sampled about 70 years ago from single locality. This species has not been collected again. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trends and highlight threats.

***Diplommatina* (s. l.) *waigeoensis* sp. nov.** (Figs 23-24, plate 27 figs 4-11, map 20)

<http://zoobank.org/E6561481-90B1-4E7B-A066-39FD16C092F3>

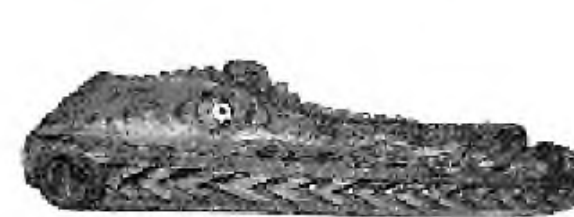
Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Majalibit Bay, Waisai 19 km NE, River Werabiai valley, 00°18'02"S, 130°56'00"E, 40-60 m, 20.II.2012, primary lowland rainforest on limestone, D.Telnov.

Paratypes 84 specimens: 25 adults, 1 subadult, 2 juv. NME, 23 adults KGC, 3 LKCNHM & 4 SMF: same label as holotype; 12 adults & 1 juv. KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10-13 km NE, 00°21'17"S, 130°54'37"E, ~70 m, 16.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 1 adult NME & 1 adult KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 3 km W, 00°26'04"S, 130°47'41"E, 40-50 m, 17.II.2012, secondary lowland rainforest on limestone, leg. D.Telnov; 2 adults, 2 subadult NME & 3 adults KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10 km NWW, 00°24'46"S, 130°44'11"E, 70-200 m, 19.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 4 adults KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4,5 km SW, Waiwo dive resort, 00°26'07"S, 130°46'45"E, 10-15 m, 21.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: Toponymic. Named after Waigeo Island, the area of origin of this species.

Measurements: Holotype H = 3 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1.2 mm. Selected paratypic specimens from type locality: H = 3.2 mm, D = 1.7 mm, HW = 1.6 mm, PD = 1.25 mm; H = 3.2, D = 1.7 mm, HW = 1.6 mm, PD = 1.3 mm. Selected paratypic specimens from Waisai 3 km W: H = 2.9 mm, D = 1.7 mm, PD = 1.2 mm; H = 2.9 mm, D = 1.65 mm, PD = 1.15 mm. Selected paratypic specimens from River Werabiai valley: H = 3.1, D = 1.75 mm, PD = 1.3 mm; H = 2.9 D = 1.6 mm, PD = 1.2 mm.

Description: Shell is small, corneous to pale orange, sinistral and rather broadly conical with convex apex. Shell with 7 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction very poorly defined by very shallow inconspicuous impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, dense, straight to slightly sinuous axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are straight to the coiling axis. There are 7 ribs per 0.5 mm. Spiral striae are very delicate, dense, becoming more distinct on the last half whorl. The aperture is not or barely tilted to the coiling axis, is subquad-



rate and has entire apertural rim. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The palatal and the basal margins of the outer peristome are distinctly sinuous. Three obtuse protrudings present each on the palatal, basal and columellar sides (last one is less distinct) of the outer peristome. There is one high and acute parietalis. There is one distinct long longitudinal palatalis situated over the columellar and the parietal sides of the aperture. The columella is shiny, obliquely twisted, forming very broad oblique basal columellaris which strongly widening backwards. One small columellar denticle, not directed downwards. The operculum is primitive - semicircular, translucent and with concentric lines.

Differential diagnosis: This new species is distinctive due to the structure of the columellaris which is provided with very broad oblique prebasal lamella. Most closely related *Diplommatina maibrat* sp. nov. from southern lowlands of Doberai Peninsula, West New Guinea (see description of this species above) but differs specifically in shorter palatalis (palatalis is twice so long in *D. waigeoensis* sp. nov.). Spiral striae are less distinct in *D. waigeoensis* sp. nov. than in *D. maibrat* sp. nov. and there is one more whorl ($W = 6$ in *D. maibrat* sp. nov.).

Ecology: Specimens were sampled from underside of wet fallen leaves in primary lowland rainforests on limestone (karst area). This species is connected with wet rainforest litter accumulating at base of limestone rocks and near buttress roots of large trees.

Distribution: Raja Ampat Islands: Waigeo Island.
Conservation status: Endangered, EN B1B2ab(iii,iv). This species inhabits both western and eastern peninsulas of Waigeo and is hitherto reported from three localities, all in the southern part of this island. The current EOO is about 100 km², the maximum EOO estimated below 5000 km² (taking into account the area of Waigeo and adjacent islets as well as available habitat). The current AOO is 20 km², but the maximum AOO estimated less than 500 km² taking into account available habitat and soil types as well as biogeographical peculiarities of Waigeo. The population size is unknown, but this species is rather abundant in primary lowland rainforests on limestone soils. The population is not fragmented. Decline in extent and quality of habitat caused by conversion of rainforest into gardens, timber collecting and small-scale logging considered the main threat for this species. It results in habitat alteration, fragmentation

and decline in AOO. Growing human population of southern Waigeo and increasing tourism in this area (both national and international) are demanding more gardens, infrastructure (roads, airport, sea ports) and resorts. Waigeo became the regency capital of Raja Ampat administrative province of Indonesia couple of years ago. This boosted local development, increasing investments into Waisai, the new regency capital. Provincial airport has been established and Waigeo Ring road was build; this happened in coastal area which was covered by primary rainforest just 10 years ago. Waigeo is initially rich in limestone rocks and the limestone is widely used for road and buildings construction. Human population is growing mostly as a result of immigration from other islands of Indonesia. New inhabitants require more firewood and charcoal. An illegal logging is rare but is a reality to reckon with. Aforementioned factors caused decline in extent of primary lowland rainforests, especially in SW of Waigeo. This trend is observed, projected and likely to continue in the future. Specimens of *D. waigeoensis* sp. nov. were not yet observed in disturbed forests. However they possible may survive also in a secondary rainforests with closed canopy (wet litter is the key). I consider there are at least two locations known for this species (W and E peninsulas of Waigeo). Between 2001-2014 south-western Waigeo lost just about 1100 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), but almost exactly in the area where *D. waigeoensis* sp. nov. occurs. Further research is required to clarify the distribution of this species and highlight the population size and trend. It is also important to clarify does *D. waigeoensis* sp. nov. occurs all over Waigeo or is limited to southern part of it.

***Moussonia* O. Semper, 1865**

Type species: *Pupa problematica* Mousson, 1865 (original designation)

Diagnosis: Shell elongate conical, dextral, oval, non-umbilicate. Protoconch whorls are smooth to finely microgranulate. Teleoconch whorls are keeled (on periphery) or rounded. Shell is smooth to finely ribbed. The ultimate whorl narrowed or not narrowed. The inner peristome forms polished callus which is at least briefly discontinued by the columellar denticle. The columellaris ends in a distinct columellar denticle at a central to basal position in the aperture. Internal lamellae include one columellaris, two parietals and one or two palatals (with some exceptions, see Table 9). The operculum is



oval or semicircular, transparent, and very thin and flexible with a calcareous plate which lacks ridges. Remark: This genus is quite polymorphic and aberrant in certain conchological characters (e.g. axial ribs and shell shape).

Distribution: Borneo, Moluccan Islands, New Guinea with satellite islands, Fiji Islands, Samoa Islands.
Diversity in the study area: Twelve species hitherto confirmed (Table 9).

Table 9. Characters matrix 4. Genus *Moussonia* O. Semper.

Legends: + present; – absent; ? – unknown; r = axial ribs on the penultimate whorl straight (1) or humped (2); rp = axial ribs in form of delicate striation (0), ribbing pattern widely-spaced throughout the teleoconch (1) or dense (2); s = axial ribs provided with setae; pr = peristomal rim; u = umbilicus open (+) or closed (-); pt = number of palatalis; prt = number of parietalis; ck = columella provided with knob (+) on simple (-); d = dextral or ss = sinistroid.

Taxon \ Character	r	rp	s	u	pr	pt	prt	ck	d / ss
<i>Moussonia ahen</i> <i>a</i>	2	2	-	-	-	?	?	?	d
<i>Moussonia echinata</i>	2	2	+	-	-	?	?	?	d
<i>Moussonia hirsuta</i>	2	2	+	-	-	?	?	?	d
<i>Moussonia hyponepia</i>	2	1	-	-	+	?	?	?	d
<i>Moussonia manuselae</i>	2	2	+	+	-	?	?	?	d
<i>Moussonia monstificabilis</i>	1	2	-	-	+	0	0	-	ss
<i>Moussonia omias</i>	2	2	-	-	+	?	?	?	d
<i>Moussonia papuana</i>	2	2	-	-	+	0	1	+	d
<i>Moussonia pseudoseparanda</i>	2	2	-	-	+	1	1	-	d
<i>Moussonia separanda</i>	2	2	-	-	+	1	2	-	d
<i>Moussonia strubelli</i>	2	2		-	-	?	?	-	d
<i>Moussonia torricelli</i>	0	2	-	-	+	1	2	-	d

***Moussonia ahen**a* (Preston, 1913)** (Plate 27 figs 12-16, map 6)
Lectotype BMNH [herewith designated]: (*Moussonia*) *ahena* [written like “*akena*”] Preston. *Diplommatina* Type Isd. of Beilan, Beilan Dutch. E. Indies. [handwritten] / Type. [printed] / *ahena* Preston. *Dutch. E. Indies. Dipl.* 1914.1.7.460. [handwritten].
Paralectotype MHUB [herewith designated]: *Zoolog. Museum Berlin.* [printed, underlined] *Moussonia ahen**a* Prest. Isd. of Beilan-Beilan Moluccen [sic!] 63795. Preston [handwritten] / 63795. [handwritten]. Another paralectotype in SMF (specimen No 105169).

Lectotype designation: Syntypic specimen from BMNH was selected as lectotype.
References: Preston (1913: 439); Zilch (1953: 39, pl. 13 fig. 198), as *Diplommatina* (*Moussonia*) *ahena*.
Measurements: Lectotype H = 2.7 mm, D = 1.2 mm, HW = 1 mm, PD = 0.8 mm. Paralectotype from MHUB H = 2.7 mm, D = 1.2 mm, HW = 1 mm, PD = 0.8 mm.
Description: Shell is very small, brown coloured, dextral, narrowly conical. Shell with 8 rather flat whorls with obtuse peripheral carina. The 1½ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse, dense,

and humped axial ribs. The ribs are equally dense on all whorls. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are strongly oblique to the coiling axis. Spiral striae are not visible at 80x magnification. The aperture is tilted about 20-25° to the coiling axis and is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The peristome is distinctly double, all its margins are not sinuous. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. One large columellar denticle directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.
Ecology: Unknown. Belangbelang Island is covered by primary lowland rainforest on limestone soil.
Distribution: Southernmost North Moluccas: Belangbelang Island of Obi Islands group. Almost certainly should be present on other islands of Obi group, particularly on limestone Obilatu Island.
Conservation status: Data Deficient, DD. *Moussonia ahen**a* is known by type specimens sampled over 100 years ago from single locality. Therefore not enough data available to calculate current EOO and AOO. The area of Belangbelang Island is 7 km². The total area of all Obi Islands is about 5100 km².



It is very unlikely *M. athena* occurs all over Obi Islands (especially not on distant Gomumu and Tobalai). Moreover, only small fractions of Obi rainforests are located on limestone soils. Consequently, the maximum EOO for this species estimated below 5000 km². The main threat for this species is loss of the habitat (lowland rainforest on limestone), but this to be confirmed. Belangbelang Island is uninhabited, but all neighbouring islands (small Bisa, Obilatu, Tapat and large Obira) are inhabited. The area covered by rainforest on Obi Islands is decreasing. Between 2001 and 2014 about 11000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). This trend is likely to continue taking into account the growing human population on the Moluccas and presence of the large nickel mine in W Obira (attracting additional workers from other regions of Indonesia). Additional research on Obira Island carried out by the Florida Museum of Natural History (2008), as well as extensive search on Bisa and Obira islands (by the Entomological Society of Latvia, 2011 & 2013) gave no results for this species. The population of *M. athena* is likely not rich or geographically restricted to limestone islands. Further research is required on Belangbelang to clarify the population size and trend. Search for *M. athena* population to be performed also on Obilatu, Tapat, as well as on Obira.

***Moussonia echinata* sp. nov.** (Plate 27 figs 20-22, map 22)

<http://zoobank.org/5A08EB55-B69F-48F8-A699-6F9B607C3E3F>

Holotype NME: INDONESIA E, West Papua, S Bird's Neck, Kaimana 40 km E, Triton bay, Lobo vill. & env., 3°45'33"S, 134°06'11"E, 15-150 m, 11-12.IX.2010, primary rainforest on limestone, leg. K.Greke.

Derivatio nominis: Named from the Latin 'echinatus' [bristly, spiny], because of the extraordinarily setose shell.

Measurements: Holotype H = 2.2 mm, D = 1.1 mm, HW = 0.8 mm, PD = 0.8 mm.

Description: Shell is small, pale brown, dextral, and narrowly conical. Shell with 7 rather flat whorls with obtuse peripheral carina, the 2 embryonic whorls are microscopically pitted. Suture deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with membranous, dense, and humped axial ribs. These ribs are equally dense on all whorls. The peripheral carina of teleoconch whorls is covered

with long membranous setae derived from the axial ribs. There are no abrupt changes in ribbing pattern. The ribs are partly synchronized with those on the previous whorls. The ribs are strongly oblique to the coiling axis. Spiral striae are only vaguely indicated on the last half of the ultimate whorl. The aperture is tilted about 25° against the coiling axis. The circular peristome is discontinued at the insertion of the columellar denticle. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double and consists of several dense lamellae in lateral view. The inner peristome forms a broad continuous polished callus. Both the inner and outer peristomes are not or only slightly sinuous. One large columellar denticle directed downwards. Because only one specimen was available for study, I did not damage the shell to observe the internal lamellae which remain unknown for this species. Operculum is unknown.

Differential diagnosis: Due to its setose shell *Moussonia echinata* sp. nov. is similar to *M. hirsuta* (Zilch, 1953) (Central Moluccas), *M. manuselae* sp. nov. (Central Moluccas; see description of this species below) and *M. strubelli* (O. Boettger, 1891) (Central Moluccas). Shells of both *M. manuselae* sp. nov. and *M. strubelli* bear rectangular microsculpture. Both species have shells of 8 whorls. The most similar species to *M. echinata* sp. nov. is *M. hirsuta* which is significantly larger (3.6 mm shell height in *M. hirsuta* compared to 2.2 mm in *M. echinata* sp. nov.), *M. hirsuta* has 8 whorls (compared to 7 whorls in *M. echinata* sp. nov.) and the second obtuse carina is present on the base of the last whorl in *M. hirsuta* (in *M. echinata* sp. nov. only one carina present).

Ecology: Found in leaf litter of primary lowland rainforest on limestone soil.

Distribution: New Guinea: Bird's Neck isthmus.

Conservation status: Data Deficient, DD. *Moussonia echinata* sp. nov. is known from a single specimen. Not enough data available to calculate current EOO and AOO. Population size and trend are unknown, as well as threats. Further research is required to gather this basic information.

***Moussonia hirsuta* (Zilch, 1953)** (Plate 27 figs 17-19)

Holotype SMF: Dipl. (*Moussonia*) *hirsuta* Fult. xx Buru [handwritten, label yellow] / Senckenbg.Mus. [printed] 105173/1 [handwritten] Frankfurt.-M. [printed] Diplommatina (*Moussonia*) *hirsuta* (Fulton) [underlined] Z. Holotypus Molukken: Insel Buru Fulton d. [handwritten] Sammlung O.v.Moellendorff [printed].



References: Fulton (1899: 213), as *Diplommatina Strubelli*, Bttg.; van Benthem Jutting (1927: 4), as *Diplommatina strubelli* Böttg.; Zilch (1953: 39, pl. 13 fig. 197).

Measurements: Holotype H = 3.6 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1.3 mm.

Description: Shell is large, brown, dextral, narrowly conical. Shell with 8 rather flat whorls with obtuse peripheral carina, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with membranous dense and humped axial ribs. The ribs are almost equally dense on all whorls. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are strongly oblique to the coiling axis. Spiral striae are distinct but poorly visible from between the ribs. The peripheral carina of teleoconch whorls is covered with long membranous setae derived from the axial ribs. The second, rather inconspicuous obtuse carina is situated on the base of the ultimate whorl. The aperture is tilted about 20-25° to the coiling axis and is circular. The apertural rim is discontinued at the insertion of the columellar denticle. The aperture is more or less strongly shifted right against the coiling axis in apertural view. The peristome is double, margins of the peristome are not sinuous. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms narrow continuous polished callus. One large columellar denticle directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Buru Island was initially covered by lowland to mid montane rainforest.

Distribution: Central Moluccas: Buru Island. Exact locality is unknown, therefore a distribution map is not given.

Conservation status: Data Deficient, DD. *Moussonina hirsuta* is known from a single specimen collected over 100 years ago. This species has not been collected again. Not enough data available to calculate current EOO and AOO. Further research is required to gather this basic information.

***Moussonina hyponepia* (van Benthem Jutting, 1958) comb. nov.** (Plate 28 figs 1-3, map 16)

Holotype NMNL: Misoöl, Waima, 0-75 m Lieftinck, M.A. 1948.09.10 [printed] / ZMA.MOLL.135954 [printed] / *Diplommatina Moussonina hyponepia* Van Benthem Jutting, 1958 [printed].

Paratypes 5 specimens NMNL: not studied.

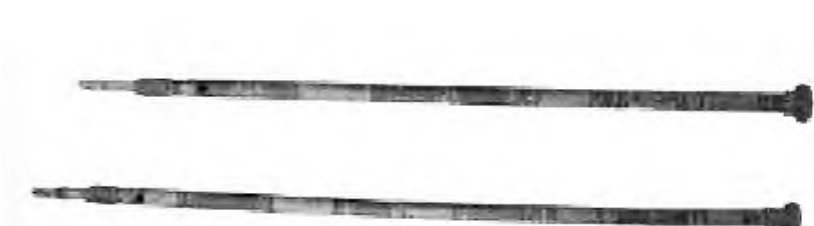
References: van Benthem Jutting (1958a: 296, 321), as *Diplommatina (Moussonina) hyponepia*.

Measurements: Holotype: H = 1 mm, D = 0.8 mm, HW = 0.45 mm, PD = 0.4 mm. Selected paratype specimens (according to the original description): H = 1 mm, D = 0.8 mm, PD = 0.5 mm; H = 0.9 mm, D = 0.8 mm, PD = 0.5 mm.

Description: Shell is very small, brown to pale-brown, dextral, short conical. Shell with 6 convex whorls with inconspicuous peripheral carina, the 2 embryonic whorls are microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is as wide or almost as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with fine, widely-spaced, indistinctly humped axial ribs. The ribs are equally dense on all whorls, but becoming more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. Spiral striae are lacking. The aperture is tilted about 35-40° to the coiling axis and is circular. The apertural rim discontinued at the insertion of the columellar denticle. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, broad in lateral view, all margins of the peristome are not sinuous. The inner peristome forms a polished callus which is discontinued near the columellar / parietal junction. The outer peristome is discontinued on the columellar side. A strong peristomal rim is present. There is one large columellar denticle, it is directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Misool Island is covered by primary lowland rainforest on limestone soils.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Data Deficient, DD. *Moussonina hyponepia* is known from type series collected over 60 years ago in NW Misool. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated about 1100 km² taking into account the area of northern and central Misool (*M. hyponepia* was not found in S and E Misool despite intense research performed in 2009 and 2012 by the Entomological Society of Latvia expeditions). The maximum AOO estimated higher but definitively under 500 km². The population size and



trend are unknown. The main threat for this species is unknown. Misool Island is still very forested and human population is comparatively small even despite continuous growth. Further research is required in order to clarify status of this species in the wild, assess its distribution, population size, trends and highlight threats.

***Moussonia manuselae* sp. nov.** (Fig. 25, plate 28 figs 4-6, map 7)

<http://zoobank.org/3C8DDE52-0E7F-46ED-95B4-20DB22DACAFA>

Holotype NME: INDONESIA E, Prov. Maluku tengah, Seram N, distr. Seram Utara, Trans-Seram road between Masohi and Sawai, Horale (former Saka) vill. ~7 km SW, river valley, 02°59'15"S, 129°02'37"E, 07.IV.2009, primary lowland rainforest, leaf litter, leg. K.Greke.

Paratypes: 1 adult KGC: same label as holotype; 1 adult & 4 juv. LKCNHM: ZRC.1999.2415 [handwritten] / Coll. J.J. Vermeulen, nr. 5302 *Diplommatina hirsuta* Zilch 1953 - Diplomm. * [printed] ZRC.1999.2415 5 nos. (1 broken) [handwritten] INDONESIA. Ceram, central part, above Moso. Rock overhang in forest. Alt. 600 m asl. Leg. A.J. Whitten, 1996. [printed] / ZOOLOGICAL REFERENCE COLLECTION DEPARTMENT OF ZOOLOGY NATIONAL UNIVERSITY OF SINGAPORE [printed] *Diplommatinidae* ZRC.MOL.10457 Ex [handwritten] ZRC. [printed] 199.2415 [handwritten] No. Spec. [printed] 5 nos. (1 broken) [handwritten] Species. [printed] *Diplommatina hirsuta* ZILCH, 1953 [handwritten] Locality [printed] Indonesia, Ceram, central part, above Moso. AH. 600 m asl [handwritten] Collector [printed] A J Whitten [handwritten] Date [printed] 1996 [handwritten] Det. by [printed] JJ Vermeulen, nr. 5302 [handwritten] Date [printed].

Derivatio nominis: Toponymic. The name derives from Manusela, Seram's famous central ridge reaching over 3000 m altitude.

Measurements: Holotype H = 2.8 mm, D = 1.5 mm, HW = 1.45 mm, PD = 1.1 mm. Paratype specimen from locus typicus H = 2.85 mm, D = 1.55 mm, HW = 1.45 mm, PD = 1.1 mm.

Description: Shell is small, dark brown, dextral, and conical. Shell with $7\frac{1}{4}$ rather flat whorls with obtuse peripheral carina, the 2 embryonic whorls are microscopically pitted. The suture is broad and very deeply, cavity-like impressed (best viewed with shell pubescence removed). The ultimate whorl is as wide as or slightly wider than the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with membranous, dense and humped axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are almost equally dense on all whorls. The ribs are strongly oblique to the coiling

axis. The peripheral carina of the teleoconch is covered with long membranous setae derived from the axial ribs. Spiral striae strong and dense, strongly wavy on lower part of the ribs. A network of conspicuous impressed, irregularly rectangular cells is developed between the spiral and axial sculpture. The aperture is tilted about 40° to the coiling axis and is circular. The apertural rim discontinued at the insertion of columellar denticle. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double. The palatal margins of both peristomes are slightly sinuous. The inner peristome forms a narrow continuous polished callus. There is one flat and obtuse transverse parietalis. One large round columellar denticle is directed downwards. The columella is very broad, obliquely twisted, forms a broad obtuse horizontal columellaris in its basal third. Operculum is unknown.

Differential diagnosis: Due to its setose shell *Moussonia manuselae* sp. nov. is similar to *M. echinata* sp. nov. (Bird's Neck Isthmus of New Guinea; see description of this species above), *M. hirsuta* (Zilch, 1953) and *M. strubelli* (O. Boettger, 1891) (last two from Central Moluccas). The new species differs specifically in less slender shell and presence of strong rectangular sculpture on the teleoconch (in *M. strubelli* similar sculpture is present but is less conspicuous). Supposedly non-setose *M. papuana* (Tapparone Canefri, 1883) (Aru Islands) differs due to the absence of the rectangular shell sculpture and in different columellaris. The most similar *M. echinata* sp. nov. is smaller (shell height 2.2 mm) and slender, has delicately spirally striate teleoconch whorls (spiral striae are distinct and dense in *M. manuselae* sp. nov.) and the peristome consists of several dense lamellae in *M. echinata* sp. nov. (the peristome consists of two lamellae in *M. manuselae* sp. nov.). *M. hirsuta* (Zilch, 1953) (Central Moluccas) is one whorl bigger and has different spiral structure.

Ecology: Specimens were sampled from underside of leaf litter in a ravine rainforest and at base of rock formations.

Distribution: Central Moluccas: Seram Island.

Conservation status: Data Deficient, DD. *Moussonia manuselae* sp. nov. is known from two localities. Not enough data available to calculate current EOO. The maximum EOO for this species is 17000 km² taking into account the area of Seram Island. The current AOO is 8 km². The maximum AOO for this species estimated over 500 km² taking into account available habitat. The population size and



trend as well as the main threat remain unknown. Further research is required to gather this basic information.

***Moussonia monstificabilis* sp. nov.** (Figs 108-109, plate 29 figs 1-8, map 16)

<http://zoobank.org/91DD77C2-3FA4-46B1-9CEE-7FACA685A217>

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06. II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 4 adults & 2 juv. NME, 10 adults, 1 sub-adult & 2 juv. KGC: same label as holotype.

Derivatio nominis: Named from Latin “monstificabilis” [outlandish, rarity, strange], because of unique twist of the shell with apex and aperture juxtaposed in same spot.

Measurements: Holotype H = 2.05 mm, D = 1.35 mm, HW = 1.75 mm, PD = 1 mm. Selected paratype specimen: H = 2.3 mm, D = 1.45 mm, HW = 1.2 mm, PD = 1.2 mm.

Description: Shell is small, brown, cylindrical and sinistroid. Shell with 7 whorls, the outer whorls are strongly convex. The five earliest whorls are dextral, only slightly convex, forming a broadly triangular shell with a flattened apex. During the 5th whorl, shell coiling reverses direction, the final 2-3 whorls form a sinistral tuba on an otherwise dextral shell. The tuba completely overgrows the initial dextral shell and the aperture is deposited on top of the dextral shell apex. The suture is moderately deeply impressed. The ultimate whorl is strongly constricted at the aperture. The pseudoumbilicus is open and perspective in the adult. The constriction is not delimited on shell wall. Teleoconch is sculptured with delicate and dense axial striations. There are no abrupt changes in the striation pattern. The ribs are not synchronized with those of previous whorls and are straight on the first 5 whorls becoming oblique after coiling reversal. Spiral striae are quite prominent and dense on all teleoconch whorls, the inner and the outer ones. There is a very dense sculpture of delicate axial striae between the ribs - about 7-9 axial striae per 20 µm. Spiral striae are very peculiar, strong and dense with impressed spaces between ribs (building cellular structure - see Figs 108-109). The aperture is tilted about 20° against the coiling axis. The circular peristomal rim is discontinued on the columellar side at the insertion of the columellar denticle. The aperture is more or less centered below the penultimate whorl in ap-

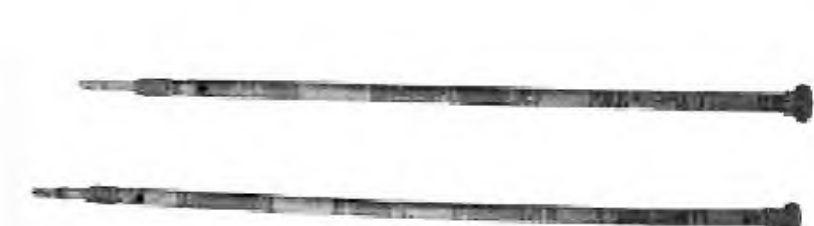
ertural view. The peristome is simple, moderately broad, discontinued at the insertion of the columellar denticle. The peristomal rim is reinforced by a strong and broad labial callus. The parietal margin of the aperture is pressed against the shell wall. The margins of the peristome are not sinuous. The peristome forms a broad polished and continuous callus. On the third whorl an acute peripheral carina develops, becoming stronger (broader) towards the first whorl and is finally visible in the aperture in a form of a large upwards directed columellar denticle (consider right shell position - see Plate 29 figs 5-7). The carina is not visible on the outer shell wall, but on the inner one (outer wall removed to see the carina). Operculum is unknown.

Differential diagnosis: No similar species are known within the family. This species is peculiar primarily due to the specific shell microsculpture and sinistroid shell. Therefore *Moussonia* is the second sinistroid genus of molluscs.

Phylogeny: A result of COI analysis for this species is unique for the available Bayesian tree of the Diplommatinidae (Clark et al. 2016). This species together with *Moussonia separanda* sp. nov. (see description of this species below) are representing a distinct and very separate clade far beyond the Cochlostomatidae, Cyclophoridae and Megalostomatidae as proposed by Webster et al. (2012). The hypothesis of the Diplommatinidae being polyphyletic is being therefore highlighted again. Thus, many Diplommatinidae taxa to be reassessed both anatomically and genetically as well as more numerous DNA analysis required for another caenogastropod groups prior any conclusions will be made (consider chapter “Phylogeny”).

Ecology: Specimens were sampled in primary lowland rainforests on limestone anticlines, at altitudes 70-350 m.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Least Concern, LC. The current EOO is about 6 km². The maximum EOO estimated less than 2000 km² taking into account the area of Misool Island and available habitat. The current AOO is 4 km². However, the real AOO is likely much higher. No data available on the population size and trend. *Moussonia monstificabilis* sp. nov. is not a common species. This species is currently known from one locality. No major threats to this species have been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing because of the establishment of new administrative division on Misool in order to attract government fundings.



Hitherto no large scale deforestation is recorded on Misool, but some areas (for example in the SE near Lilinta vill.) suffered from small-scale illegal logging over a decade ago. Significant decline in EOO, AOO or quality of habitat cannot be projected for this species within next 10 years. Further research is required on the distribution of this species as well as on threats to it.

***Moussonia omias* (van Benthem Jutting, 1958)**
comb. nov. (Plate 28 figs 7-9, map 16)

Holotype NMNL: Misoöl, Waima, 0-75 m Lieftinck, M.A. 1948.09.10 [printed] /ZMA.MOLL.135959 [printed] / Diplommatica omias Van Benthem Jutting, 1958 [printed].

Paratypes 52 NMNL: same labels as holotype.

References: van Benthem Jutting (1958a: 296, 319), as *Diplommatica* (*Moussonia*) *omias*.

Measurements: Holotype H = 2.8 mm, D = 1.4 mm, HW = 1.3 mm, PD = 1 mm. Selected paratypic specimens (according to the original description): H = 2.4 mm, D = 1.3 mm, PD = 0.9 mm; H = 2.9 mm, D = 1.4 mm, PD = 1 mm; H = 2.6 mm, D = 1.3 mm, PD = 0.8 mm.

Description: Shell is small, brown to reddish-brown, dextral and short conical. Shell with 7 somewhat convex whorls with inconspicuous peripheral carina, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is as wide or almost as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with fine, dense, and indistinctly humped axial ribs. The ribs are equally dense on all whorls, but becoming more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are strongly oblique to the coiling axis. Spiral striae are lacking. The aperture is tilted about 35-40° to the coiling axis and is circular. The apertural rim discontinued at the insertion of the columellar denticle. The aperture is shifted right against the coiling axis or slightly shifted right in apertural view. The parietal margin of the aperture is not fully attached to the ultimate whorl. The peristome is double, broad in lateral view. Peristomal margins are not sinuous and are discontinued on the columellar side. The inner peristome forms a continuous polished callus. A strong peristomal rim is present. One large columellar denticle directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Misool Island is covered by pri-

mary lowland rainforests on limestone soils.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Data Deficient, DD. *Moussonia omias* is known from type series sampled over 65 years ago from three localities in NW Misool Island. This species has not been collected again. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated 1100 km² taking into account the area of northern and central Misool (this species was not found in the South and East of Misool despite intense research in 2009 and 2012 by the expeditions of the Entomological Society of Latvia). The maximum AOO is definitively below the threshold of 500 km². The population size and trend are unknown, but *M. omias* was locally abundant. The main threat for this species cannot be identified. Misool Island is still forested for over 75% and human population is small despite continuous growth. Further research is required on the distribution, population size as well as on threats for *M. omias*.

***Moussonia papuana* (Tapparone Canefri, 1883)**
(Figs. 26-27, plate 28 figs 10-13)

Lectotype MSNG: Museo Civico di Storia Natur. di Genova Molluschi della Nova Guinea [printed] 273 [handwritten] . Coll. O. Beccari [printed] Moussonia Papuana Tapparone Canefri [handwritten] Ann.Mus.Civ. Genova [printed] XIX [handwritten] p. [printed] 269 Wokan [sic!], is. Aru [handwritten] / Museo Civico di Storia Naturale di Genova [printed] Moussonia papuana Tapp. Ann.M.G. XIX, 1883, p. 269, t. X, f. 16-17. Typus! Is. Aru: Vokan [sic!], 1873. O.Beccari! [handwritten] / HOLOTYPE [printed] / ICONOTYPE [printed].

Paralectotypes 26 adults: 23 adults MSNG: Museo Civico di Storia Natur. di Genova Molluschi della Nova Guinea [printed] 273 [handwritten] Coll. O. Beccari [printed] Moussonia Papuana Tapparone Canefri [handwritten] Ann.Mus.Civ.Genova [printed] XIX [handwritten] p. [printed] 269 Wokan [sic!], is. Aru [handwritten] / Museo Civico di Storia Naturale di Genova [printed] Moussonia papuana Tapp. Ann.M.G. XIX, 1883, p. 269, t. X, f. 16-17. Typus! Is. Aru: Vokan [sic!], 1873. O.Beccari! [handwritten] / PARATYPEN [printed]; 3 adults FMNH: 118376 [printed] / 118376 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 3 dry specs. Paralectotype(s): Moussonia papuana Tapparone Canefri, 1883 Sta. OB-118376, Indonesia, Moluccas, Aru Islands, Wokan O. Beccari! Ex Museo Civico di Storia Naturale di Genova 'Giacomo Doria' (Acc.# 14301) [printed].

References: Tapparone Canefri (1883: 269, pl. 10 figs 16-17); Kobelt (1886: 174); Kobelt & von Möllendorff (1898: 142), checklist, as *Diplommatica* subgen. *Moussonia papuana*; Kobelt (1902: 420), as *Diplommatica* (*Moussonia*) *papuana*;



Boettger C.R. (1922: 359, 362, 402, pl. 22 fig. 35); van Benthem Jutting (1953: 288, 312), as *Diplommatina papuana*; Zilch (1953: 39), as *Diplommatina (Moussonia) papuana*; van Benthem Jutting (1962: 10), as *Moussonia papuana (Diplommatina papuana)*, lectotype designation; van Benthem Jutting (1963: 711), as *Diplommatina papuana*; Vermeulen (1996c: 112), as *Diplommatina papuana*; Monk et al. (1997: 395), as *Diplommatina papuana*; Egorov (2013: 21, fig. 34b), as *Diplommatina (Moussonia) papuana*.

Measurements: Lectotype H = 2.2 mm, D = 1.1 mm, HW = 0.95 mm, PD = 0.75 mm. Selected paralectotypes: H = 2.1 mm, D = 1.1 mm, PD = 0.7 mm; H = 1.9 mm, D = 1 mm, PD = 0.7 mm.

Description: Shell is very small, brownish, dextral and narrowly conical. Shell with 7 convex whorls with obtuse peripheral carina, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is slightly narrower than the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse, dense, humped axial ribs. The ribs are equally dense on all whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. Spiral striae are lacking. The aperture is tilted about 30-40° to the coiling axis and is circular. The apertural rim discontinued at the insertion of the columellar denticle. The aperture is shifted right against the coiling axis in apertural view. The peristome is double. The margins of the peristome are not sinuous. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms polished callus which is discontinued at the insertion of columellar denticle. There is one short high and acute parietalis. The columella is broad, obliquely twisted, forming a broad and umbrella-like columellaris in its basal third. One large columellar denticle directed downwards. Operculum is unknown.

Ecology: Unknown. Tanahbesar Island is covered with primary lowland rainforests on limestone soils. Distribution: Aru Islands: Tanahbesar (= Wokam) Island, possible also another islands of Aru group. Record from Ambon Island in Central Moluccas (van Benthem Jutting 1953) is supposedly based on misidentified specimen which has not been available for this study. Exact locality is unknown, therefore a distribution map is not given.

Conservation status: Data Deficient, DD. *Moussonia papuana* is known from type series sampled over 100 years ago from single locality. Not enough

data available to calculate current EOO and AOO. The area of Tanahbesar Island is ~1600 km² but the total land area of Aru Islands is about 6270 km². It is very unlikely *M. papuana* occurs all over Aru Islands (particularly not on southern part of Tarangan (= Trangan) Island which is known by its savannah-like vegetation). Consequently, the maximum EOO for this species estimated 9800 km² (including numerous small islands adjacent to Aru). The main threat is unknown. The area of Aru Islands covered by rainforests is slowly decreasing, between 2001 and 2014 about 7500 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Present human population is small but it is also increasing. Additional research is needed to clarify status of this species in the wild, assess its population size as well as highlight threats.

***Moussonia pseudoseparanda* sp. nov.** (Figs 28-30, plate 29 figs 9-12, map 24)

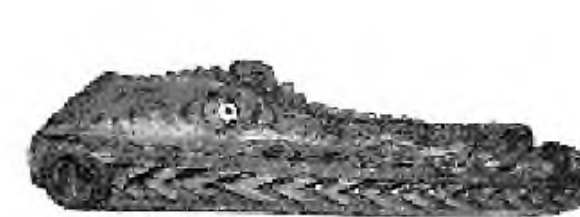
<http://zoobank.org/0F56CE0F-AEA5-4ED1-AF0C-B823585CF89F>

Holotype NME: INDONESIA E, West PAPUA, Onin Peninsula, Fak-Fak 10 km E, 2°56'32"S, 132°23'01"E, Sakarteman vill. 1-4 km W, River Sakarteman valley, 350-450 m, 26.IX.2010, primary lowland rainforest on limestone, leg. K.Greke.

Derivatio nominis: Named from the combination of Latin "pseudo" + "separandus" [separated], because of strong similarity in shell shape and structure with *Moussonia separanda* sp. nov. (see description of this species below).

Measurements: Holotype H = 2.3 mm, D = 1.45 mm, HW = 1.2 mm, PD = 1.2 mm.

Description: Shell is small, dextral, broadly conical with flattened apex, coloured brown on early whorls and pale brown on the last two whorls. Shell with 6⅔ whorls, early ones are rather flat but younger ones - convex. The 2 embryonic whorls are microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is constricted; it is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with very delicate and very dense axial striation. There are no abrupt changes of the striation pattern. The ribs are not synchronized with those of the previous whorls and are strongly oblique to the coiling axis. Spiral striae are very delicate and dense, poorly visible at 200x magnification. The aperture is tilted about 30° to the coiling axis and is ovoid. The apertural rim is broadly discontinued at the insertion of columel-



lar denticle. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the aperture attached to the ultimate whorl. The peristome is simple, moderately broad in lateral view. A peristomal rim is situated close to the peristome and is reinforced by a strong and broad labial callus. The palatal and the basal margins are sinuous. The peristome forms rather narrow polished callus which is discontinued at the insertion of columellar denticle. There is one very strong acute and high parietalis ending at the columella. There is one flat palatalis situated over the columellar denticle. There is One large columellar denticle directed downwards. The columella is broad, strongly twisted, forming a broad umbrella-like oblique columellaris in its basal third. The columellaris increases in width towards the shell interior and is provided with a large flat knob which is directed upwards (Figs 28-29). The operculum is primitive - semicircular, very thin and transparent with a few concentric lines.

Differential diagnosis: Very conspicuous species primarily due to the specific shell shape. Conchologically very similar to *Moussonia separanda* sp. nov. (Misool Island; see description of this species below) but differs specifically in having simple parietalis (parietalis Y-like, merging from two teeth in *M. separanda* sp. nov.), the palatalis being shorter and less conspicuous compared with the pt in *M. separanda* sp. nov. and in presence of the conspicuous upwards-directed knob in the interior of the twisted columellaris (this knob is less conspicuous and more or less horizontal in *M. separanda* sp. nov.).

Ecology: Specimen was sampled in primary lowland rainforest on limestone at altitude 350-450 m.

Distribution: West New Guinea: Onin Peninsula.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO for this species also cannot be projected. The current AOO is 4 km², but the maximum AOO is likely higher. The population size and trend are unknown. The main threat for this species cannot be identified. Since this species is known from lowland areas it is likely endangered by ongoing decline in primary rainforests. Further research is required in order to clarify species distribution, population size, trends and highlight threats.

***Moussonia separanda* sp. nov.** (Figs 31-34, 110, plate 30 figs 1-9, map 17)

<http://zoobank.org/9C9B6A95-4FF4-42C4-8063-2641203FC651>

Holotype NME: INDONESIA E, Raja Ampat, Misool Is-

land (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov. Paratypes 7 specimens: 2 adults NME & 2 adults KGC: same label as holotype; 3 adults KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 1 adult KGC [collected dead]: INDONESIA E, Prov. Raja Ampat, distr. Misool Barat, Lilinta (Lelintah) vill. ~20 km SW, Yan Island, 02°07'53"S, 130°07'17"E, 02.IV.2009, primary coastal semidry vegetation, under rotten log, leg. K.Greke [collected dead].

Derivatio nominis: Named from Latin "separandus" [separated], because of distant phylogenetic position of this species from another Diplommatiniidae (see "Phylogeny" section below).

Measurements: Holotype H = 2.6 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1 mm. Selected paratype specimens: H = 2.6 mm, D = 1.5 mm, HW = 1.3 mm, PD = 1 mm; H = 2.5 mm, D = 1.5 mm, HW = 1.45 mm, PD = 0.95 mm.

Description: Shell is small, dextral, broadly conical with flattened apex, reddish brown coloured on early whorls, yellowish brown on younger ones. Shell with 7 whorls, older ones are rather flat but younger ones are convex. The 1½ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is constricted, as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with very delicate and very dense axial striation. There are no abrupt changes of the striation pattern. The ribs are not synchronized with those of the previous whorls and are strongly oblique to the coiling axis. Spiral striae are very delicate and dense as visible at 200x magnification. The aperture is tilted about 30-35° to the coiling axis and is ovoid. The apertural rim is discontinued at the insertion of the columellar denticle. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the aperture is attached to the ultimate whorl. The peristome is simple, moderately broad in lateral view. A peristomal rim is situated close to the peristome and is reinforced by a strong and broad labial callus. The peristome forms a broad continuous polished callus. The palatal and the basal margins of the peristome are sinuous. There are two rather flat parietalis which merge together and form one strong acute parietalis which is ending at the columella. There is one long palatalis situated over the parietal side of the peristome. One large columellar denticle directed downwards.



The columella is broad, strongly twisted, forms a broad and umbrella-like oblique columellaris in its basal third. The columellaris increases in width towards the shell interior and is provided with a large flat knob. The operculum is primitive - semicircular, very thin and transparent and with few concentric lines.

Differential diagnosis: See diagnose of *M. pseudoseparanda* sp. nov.

Phylogeny: A result of COI analysis for this species is unique for the available Bayesian tree of the Diplommatinidae (Clark et al. 2016). This species together with *Moussonia monstificabilis* sp. nov. (see description of this species above) are representing a distinct and very separate clade far beyond the Cochlostomatidae, Cyclophoridae and Megalostomatidae as proposed by Webster et al. (2012).

Ecology: Specimens were sampled from under large fallen leaves on limestone anticlines in primary lowland rainforest at altitudes 70-350 m.

Distribution: Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. The current EOO is about 10 km² (since dead specimen of this species was found on shore of tiny and dry Yan islet, I consider this specimen was washed out from Misool forests rather than it also inhabits arid Yan islet where only bushy vegetation is present; therefore Yan is excluded from my EOO calculation). The maximum EOO estimated less than 2000 km² taking into account the area of central and southern Misool Island and available habitat (this species was not found on N and NW Misool). The current AOO is 8 km². The maximum AOO is definitively higher. There are no data available on the population size and trend. *Moussonia separanda* sp. nov. is not abundant. This species is currently known from two close-standing sites (again, Yan Island finding is not considered here). No threats to this species were identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing, especially because of establishing new administrative divisions on this island in order to attract government fundings. Hitherto no large scale deforestation recorded on Misool, but some areas (for example in the SE near Lilinta vill.) suffered from small-scale illegal logging over two decades ago. I cannot project any significant decline in the EOO, AOO or quality of the habitat within next 10 years. Further research is required on distribution of this species and on threats for its population.

***Moussonia strubelli* (O. Boettger, 1891)** (Plate 28
figs 14-16, map 8) nec *Diplommatina Strubelli*
E.A. Smith, 1894

Holotype SMF: Dipl. (Moussonia) strubelli Bttg. Hitulama auf Hitu, N. Amboina *Strub. 91. [handwritten] / Senckenbg.Mus. [printed] 105170/1 [handwritten] Frankfurt.-M. [printed] Diplommatina (Moussonia) strubelli Bttgr. [underlined] Holotypus! Orig. 1891 T. 4 F: 3 N-Amboina: Hitulama auf Hitu A.Strubell 1891 [handwritten] Sammlung O.Boettger [printed].

Note: E.A. Smith (1894: 463) described *Diplommatina Strubelli* from Natuna Islands not being aware this name was already used by O. Boettger in 1891 (see note by E.A. Smith 1903).

References: O. Boettger (1891: 285, pl. 4 fig. 3), as *Diplommatina (Moussonia) Strubelli*; Kobelt & von Möllendorff (1898: 142), checklist, as *Diplommatina* subgen. *Moussonia Strubelli*; Kobelt (1902: 478), as *Diplommatina (Moussonia) Strubelli*; van Benthem Jutting (1953: 288, 312), as *Diplommatina strubelli*; Zilch (1953: 39); Monk et al. (1997: 395), as *Diplommatina strubelli*.

Measurements: Holotype H = 2.7 mm, D = 1.3 mm, HW = 1.2 mm, PD = 1.1 mm.

Description: Shell is large, dextral, narrowly conical, pale brown coloured. Shell with 7¼ convex whorls with rather acute peripheral carina, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse, dense, humped axial ribs. The ribs are almost equally dense on all whorls but become more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. Spiral striae are dense but slightly visible from under the axial ribs. It consists of irregular poorly defined rectangular cells. The peripheral carina of teleoconch is provided with long membranous setae deriving from the axial ribs. The aperture is tilted about 30° to the coiling axis and is circular. The apertural rim is discontinued at the insertion of the columellar denticle. The aperture is shifted right against the coiling axis in apertural view. The peristome is double, the inner one is discontinued at the insertion of columellar denticle. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a polished callus on the palatal and the basal sides. The palatal margin of the outer peristome is sinuous. One large columellar denticle, directed slightly



downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: Central Moluccas: Ambon Island. Records from Buru Island (Fulton 1899; van Benthem Jutting 1927) refer to *Moussonia hirsuta* (Zilch, 1953).

Conservation status: Data Deficient, DD. *Moussonia strubelli* is known from a single specimen collected over 100 years ago. Not enough data available to calculate current EOO and AOO. Further research is required to clarify status of this species in the wild, its distribution, population size, trend and define threats.

***Moussonia torricelli* sp. nov.** (Figs 35-36, plate 28 figs 17-21, map 23)

<http://zoobank.org/59429A4C-73C5-45F0-8C65-A21B490DD015>

Holotype UF (No 380574): UF 380574 Mollusca, Diplommatinidae 1 specimen(s) *Palaina* [printed] sp.4 [handwritten] Papua New Guinea, Sandaun Province Sinberien, base of S slope of Mount Sapau, 4 km NW of Parkop Village, 7 km NW of Sibilanga Mission wet hill forest along alkaline stream 526 meters -3.3975° 142.5288° Slapcinsky, J. 22 May 2005 JS-0798 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS-798 „Palaina“ [handwritten].

Paratypes 14 specimens: 1 adult & 3 juv. UF: UF 380628 Mollusca, Diplommatinidae 5-spec. [sic! only one specimen available] *Palaina* Papua New Guinea, Sandaun Province Sindik, 0.3 km NW of Parkop Village, 3 km NW of Sibilanga Mission broadleaf tropical hill forest 426 meters -3.4232° 142.5213° Slapcinsky, J. 14 May 2005 JS-0793 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 793 [handwritten]; 1 adult & 2 juv. UF: UF 380586 Mollusca, Diplommatinidae 3 specimen(s) *Palaina* [printed] sp.4 [handwritten] Papua New Guinea, Sandaun Province Wayayane, 1 km N of Parkop Village, 4 km NW of Sibilanga Mission hill forest 565 meters -3.4194° 142.5269° Slapcinsky, J. 16 May 2005 JS-0794 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS-794 „Palaina“ [handwritten]; 3 adults UF & 1 KGC: UF 380602 Mollusca, Diplommatinidae 4 specimen(s) *Palaina* [printed] sp. 4 [handwritten] Papua New Guinea, Sandaun Province Maibu, base of S slope of Mount Sapau, 4 km NW of Parkop Village, mature hill forest along river 550 meters -3.3945° 142.528° Slapcinsky, J. 23 May 2005 JS-0799 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / Dipplomattinidae [sic!] JS-799 [handwritten]; 1 adult & 2 juv. UF: UF 380640 Mollusca, Diplommatinidae 3 specimen(s) *Palaina* [printed] sp.4 [handwritten] Papua New Guinea, Sandaun Province Smanmoke, base of S slope of Mount Sapau, 4 km NW of Parkop Village, mature hill forest along river 561 meters -3.3926° 142.5298° Slapcinsky, J. 24 May 2005 JS-0800 dry FLORIDA MUSEUM OF NATU-

RAL HISTORY [printed] / JS-800 *Palaina* [handwritten]; 2 adult & 1 subadult UF: UF 380680 Mollusca, Diplommatinidae 3-spec. *Palaina* Papua New Guinea, Sandaun Province Smanmoke, base of S slope of Mount Sapau, 4 km NW of Parkop Village, mature hill forest along river 561 meters -3.3926° 142.5298° Slapcinsky, J. 24 May 2005 JS-0800 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / brown diplom. JS-800 [handwritten] [shells are dissolved in these specimens].

Derivatio nominis: Toponymic. This species is named after Torricelli Mountains in northern New Guinea where it was first found. Noun in apposition, invariable.

Measurements: Holotype H = 1.3 mm, D = 0.75 mm, HW = 0.6 mm, PD = 0.5 mm. Selected paratype specimens: H = 1.3 mm, D = 0.75 mm, HW = 0.6 mm, PD = 0.5 mm; H = 1.3 mm, D = 0.7 mm, HW = 0.65 mm, PD = 0.5 mm.

Description: Shell is very small, reddish- to orange-brown, dextral, short conical with flattened apex. Shell with 6 convex whorls, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The constriction is not delimited on shell wall. The teleoconch is sculptured with extremely delicate dense axial striation, poorly visible at 80x magnification. No abrupt changes of the striation pattern. Spiral striae are lacking. The aperture is tilted about 30° to the coiling axis, is narrowly oval. The apertural rim is entire. The aperture is slightly shifted right against the coiling axis in apertural view. The columellar side of the aperture is almost straight, the basal / columellar and the columellar / parietal junctions are angulate. The peristome is simple, broad in lateral view. The margins of the peristome are not sinuous. Peristomal rim situated distant from the peristome, reinforced by a strong and broad labial callus. The parietal margin of the aperture attached to the ultimate whorl. The peristome forms a narrow polished callus which is parietally discontinued. There are two strong acute and high parietalis. There is one γ -like palatalis situated over the columellar side of the aperture. There is One large columellar denticle directed downwards. The columella is broad and smooth, strongly twisted, forming a broad and umbrella-like oblique columellaris in its basal third. The columellaris increases in width toward the shell interior; a part of it is visible in the aperture above the columellar denticle. Operculum is unknown.

Differential diagnosis: This is one of the smallest among Papuan *Moussonia*. This species is peculiar among all congeners due to the structure of



the internal lamellae (see above), extremely delicate axial striation, presence of a broad labial cal-
lus on the peristomal rim and in the angulate aper-
ture (see above).

Ecology: Specimens were sampled at altitudes
426-565 m in primary lowland rainforests along
streams and river.

Distribution: Northern New Guinea: Torricelli
Mountains.

Conservation status: Data Deficient, DD. The
current EOO is about 20 km², but the maximum
EOO is definitely much larger. The current AOO is 12
km², the maximum AOO is likely higher. The popula-
tion size and trend are unknown, but *Moussonia*
torricelli sp. nov. seems not an abundant species.
The main threat for this species cannot be identi-
fied. Since this species is known from low altitudes
at the foot of the Torricelli ridge it is potentially en-
dangered by deforestation and expansion of gar-
dens. Further research is required in order to clarify
species distribution, population size, trends and
highlight threats.

***Palaina* s. l. O. Semper, 1865**

Type species: *Diplommatina macgillivrayi* L.G.K.
Pfeiffer, 1854 (subsequent designation by Iredale
1944: 303)

= *Anostomella* Martens, 1867 **syn. nov.**

Type species: *Pupa ascendens* Martens, 1864b
(original designation)

New synonymy: There are no sufficient concho-
logical characters to distinguish *Anostomella* from
Palaina. Phylogenetic assessment made in 2016
(see Phylogeny chapter below) supports this deci-
sion since there is no significant distance between

Palaina angulata and *Anostomella ascendens*
(both species from Lease Islands).

Diagnosis: Shell is cylindrical or oval, dextral or
sinistral, the constriction without teeth. The colu-
mellaris is present but not visible in the aperture.
The operculum in many species with concentric
periostracal ridges (lamellae) or spiral lines, as well
as median appendages (e.g. tuba-like) on the outer
surface. According to Kobelt (1902) the “tuba” (the
area beyond the constriction) of *Palaina* is about ¾
ultimate whorl and of *Arinia* - about ½ a whorl, but
this character is variable. In many Papuan *Palaina*
making it an unreliable character in determining
species relationships.

Remark: This genus is polymorphic and aberrant
in conchological characters. As a result, there have
been numerous attempts made to split *Palaina* into
multiple subgenera (Table 10). The set of concho-
logical characters used for defining these genera
are polyphyletic and certain species have traits of
the different groups. On the basis of my preliminary
DNA-based phylogenetic studies I confirm Papuan
Palaina s. l. as a monophyletic group (see also re-
sults by Webster et al. 2012). Further DNA stud-
ies are required to elucidate species relationships
within each genera.

Distribution: Far East of Russia (Primorsky Krai),
Japan, Korean Peninsula, Sundaland, the Philip-
pines, Papuan Region, Vanuatu, eastern Austra-
lia, New Caledonia, Fiji and western Oceania. The
range of this genus in the west is not clearly ascer-
tained because generic limits between *Palaina* and
Arinia are not clear.

Diversity in the study area: Seventy seven
species hitherto confirmed (Table 11; next page).

Table 10. Satellite taxa of *Palaina* O. Semper, 1865 (according to Egorov 2013).

Taxon, author	Distribution
<i>Cylindropalaina</i> von Möllendorff, 1897	Far East of Russia, Japan, Korean Peninsula, Sunda- land, the Philippines, Papuan Region, Vanuatu, Palau Islands, New Caledonia
<i>Fermepalaina</i> Iredale, 1945	Norfolk Island
<i>Macropalaina</i> von Möllendorff, 1897	Caroline Islands, Fiji, New Caledonia
<i>Palmatina</i> Iredale, 1944	Norfolk Island
<i>Velepaina</i> Iredale, 1937	East Australia



Table 11. Characters matrix 5. Genus *Palaina* O. Semper.

Legends: + present; – absent; +/- or 1/2 – character indistinct; ? – unknown; b = shell with a strong bulb beyond the constriction; r = axial ribs on the penultimate whorl straight (1), sinuous (2) or specifically shaped (3); rp = axial ribs absent on two last whorls (0), ribbing pattern widely-spaced throughout the teleoconch (1), dense (2) or ribbing pattern changes abruptly (3); ss = spiral striae present on the penultimate and ultimate whorls at 80x magnification (+) or absent (-); l = axial ribs developed in a form of high lamellae (+) or not (-); u = umbilicus open (+) or closed (-); ap = position of the aperture central (c), shifted left (l) or right (r); p = peristome is simple (1), double (2) or triple (3); ck = columella simple or with flat callus (-) or provided with knob (+); o = operculum is primitive (-) or derivative (+); d = dextral or s = sinistral.

Taxon \ Character	b	r	rp	ss	l	u	ap	p	ck	o	d / s
<i>Palaina adelpha</i>	-	1	2	+	-	-	l	2	?	+	s
<i>Palaina aerari</i> (= <i>megamorpha</i> syn. nov.)	-	1	1	-	-	-	c	2	?	?	s
<i>Palaina albrechti</i>	-	1/2	2	+	-	-	c	3	-	-	s
<i>Palaina angulata</i>	-	1/2	1/2	+	-	-	c	2	-	+	d / s
<i>Palaina ascendens</i>	-	2	2	-	-	-	r	1/2	+		d
<i>Palaina attenboroughi</i>	-	2	1	+	+	-	c	2	-	+	s
<i>Palaina beilanensis</i>	-	1/2	2	+	-	-	c	3	?	?	s
<i>Palaina bicornis</i>	-	1/2	2	+	-	-	c	2	-	-	s
<i>Palaina biroi</i>	-	2	2	+	-	-	c	2/3	-	+	s
<i>Palaina bougainvillei</i>	-	1	2	-	-	-	c	2	-	+	s
<i>Palaina brazieri</i>	-	2	1	-	-	-	c	2	?	?	d
<i>Palaina bundiana</i>	-	2	2	-	-	-	c	2	?	-	s
<i>Palaina carbavica</i>	-	1	2	+	-	-	c	2	+	+	d
<i>Palaina chrysostoma</i>	+	2	3	-	-	-	c	2	-	+	d
<i>Palaina citrinella</i>	-	2	2	+	-	-	c	2	-	-	s
<i>Palaina clappi</i>	-	2	2	-	-	-	l	1	?	?	s
<i>Palaina commixta</i> (= <i>commixta jacquinoti</i> syn. nov.)	-	1/2	2	+	-	-	c	2	-	+	s
<i>Palaina consobrina</i>	-	2	2	+/-	-	-	c	2	?	?	s
<i>Palaina cupulifera</i>	-	3	1	+	-	-	l	2	?	?	s
<i>Palaina dianctoides</i>	+	1/2	2	+	-	-	r	2	?	+	d
<i>Palaina diepenheimi</i>	-	2	1	+	-	-	r	2	?	?	d
<i>Palaina doberai</i>	-	1	2	-	-	-	c	2	+	-	s
<i>Palaina dohertyi</i>	-	2	1	+	+	-	c	2	+	+	s
<i>Palaina erythropeplos</i>	-	1	2	+	-	+	c	2	?	?	s
<i>Palaina extrema</i>	-	1	1	+	-	-	c	2	+	-	s
<i>Palaina flavocylindrica</i>	-	1	2	-	-	-	c	2	-	+	s
<i>Palaina floridensis</i>	-	1	2	+	-	-	c	1	?	?	s
<i>Palaina gardneri</i> (= <i>delli</i> syn. nov.)	-	2	2	-	-	-	r	2	?	+	d
<i>Palaina glabella</i>	-	1	1	+	-	+/-	c	2	?	?	s
<i>Palaina granulum</i>	-	1	3	-	-	-	c	2	?	?	s
<i>Palaina hartmanni</i>	-	1/2	3	+	-	-	c	2	-	+	s
<i>Palaina iha</i>	-	1/2	1	+	-	-	c	2	-	-	s
<i>Palaina imperfecta</i>	-	1	1	-	-	-	c	3	-	?	s
<i>Palaina inconspicua</i>	-	1	2	-	-	-	c	2	?	?	s
<i>Palaina insulana</i>	-	1	1/2	-	-	-	c	3	?	?	s
<i>Palaina laszloi</i>	-	1	1	-	-	-	c	2	+	+	s
<i>Palaina lengguru</i>	-	2	3	+	-	-	c	2	-	+	s
<i>Palaina leptotoreutos</i>	-	1	2	+	-	-	c	2	?	?	s
<i>Palaina liliputana</i>	-	1	2	+	-	-	c	2	?	?	s
<i>Palaina lousiade</i>	-	1	2	-	-	-	l	2	-	+	s
<i>Palaina mairasi</i>	-	2	2	+	-	-	c	2	-	+	d
<i>Palaina manggaraica</i>	-	1	2	-	-	-	c	2	-	+	d
<i>Palaina megalostoma</i>	-	2	2	-	-	-	c	2	+	+	s
<i>Palaina mengen</i>	-	1/2	2	+	-	-	c	2	-	+	s
<i>Palaina minuscularia</i>	-	1/2	2	+	-	-	c	2	+	+	s
<i>Palaina minutula</i>	-	1	1	-	-	-	r	2	?	?	d
<i>Palaina mirifica</i>	-	1	3	-	-	-	c	2	-	+	s
<i>Palaina misoolensis</i>	-	1	2	+	-	-	c	2	+	+	s
<i>Palaina mutis</i>	-	2	2	-	-	+	l	2	-	+	s
<i>Palaina novoguineensis</i>	+	2	2	+	-	-	c	2	-	+	d
<i>Palaina novopommerana</i> (= <i>vexator</i> syn. nov.)	-	2	2	-	-	-	c	2	-	+	s
<i>Palaina obiensis</i>	-	1	3	-	+	-	c	2	+	+	s
<i>Palaina onin</i>	-	1/2	2	+	-	-	c	2	-	+	s
<i>Palaina papuamontis</i>	-	1	2	+	-	+	c	1	-	+	s
<i>Palaina papuanorum</i>	-	1/2	3	+	-	-	l	2	?	?	s



Table 11 (continued).

<i>Palaina paradisaea</i>	-	1	3	+	-	-	c	2	+	+	s
<i>Palaina perspectiva</i>	-	2	3	+	+	+	l	2	-	?	s
<i>Palaina polystoma</i>	+	1/2	2	-	-	-	c	2	-	+	d
<i>Palaina ponsonbyi</i>	-	2	2	-	+/-	-	c	2	?	?	s
<i>Palaina propinqua</i>	-	2	2	-	-	-	c	2	?	?	s
<i>Palaina psittricha</i>	-	1/2	3	+	-	-	l	2	-	+	s
<i>Palaina quadricornis</i>	-	1	2	+	-	-	c	2	-	?	s
<i>Palaina repandostoma</i>	-	1	2	-	-	-	l	1/2	?	?	s
<i>Palaina scaevola</i>	-	2	1	+	-	-	c	2	?	?	s
<i>Palaina schneideri</i>	-	1/2	3	-	-	-	c	1/2	?	?	s
<i>Palaina silvicultrix</i>	-	1	1	-	-	-	c	2	-	?	s
<i>Palaina slapcinskyi</i>	-	1	3	+	-	+	c	2	-	+	s
<i>Palaina solomonensis</i>	-	1/2	1	+	-	-	c	2	?	?	d
<i>Palaina sparselamellata</i>	-	1/2	2	-	+	-	c	2	-	+	s
<i>Palaina tanimbarensis</i>	-	3	3	+	+	-	c	2	-	?	s
<i>Palaina telnovi</i>	+	1/2	3	-	-	-	c	2	+	+	d
<i>Palaina thomasrinteleni</i>	-	3	2	-	+	-	c	2	-	?	d
<i>Palaina vermeuleni</i>	+	1	3	-	-	-	c	1	-	?	d
<i>Palaina waigeo</i>	-	1/2	3	+/-	-	-	c	2	-	-	s
<i>Palaina wawiyai</i>	+/-	1	1	-	-	-	c	2	-	?	s
<i>Palaina wisemani</i>	-	1/2	1	-	-	-	c	1	?	?	s
<i>Palaina yamdena</i>	-	1	2	+	-	-	c	2	-	?	s

***Palaina* (s. l.) *adelpha* Soós, 1911** (Plate 31 figs 1-6, map 26)

Material 3 adults UWCP: *Palaina adelpha* Soós, 1911 Det.A.Wiktor 1996 [printed] / Museum of Nat.Hist. Wrocław Papua-New Guinea, prov. Madang N of Nuru river ca 40 km SW of Madang in primeval rain forest, ca 100 m a.s.l. Leg. A.Wiktor 18.10.1990 No.2551 [printed].

Note: Soós’ type collection was lost in the fire at the Hungarian Natural History Museum. Redescription is based on specimens collected from the type locality by Wiktor (1998).

References: Soós (1911: 348); Leschke (1912a: 143); Leschke (1912b: 73); van Benthem Jutting (1963: 702); Wiktor (1998: 16).

Measurements: Specimens from Madang env. H = 2 mm, D = 1 mm, HW = 1 mm, PD = 0.75 mm; H = 1.9 mm, D = 0.9 mm, HW = 0.9 mm, PD = 0.75 mm; H = 1.9 mm, D = 1 mm, HW = 1 mm, PD = 0.7 mm.

Description: Shell is very small, whitish, yellowish or pale rose, sinistral, cylindrical, with broadly conical apex. Shell with 6¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed, especially for the ultimate whorl. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with very coarse, dense, straight ribs. The ribs becoming denser and more delicate in apertural view of the ultimate whorl. On the last half whorl the ribs becoming very coarse (thick) and 2x more widely-spaced. These changes in the ribbing pattern are not abrupt. The ribs are not synchronized with those of the previous whorls and are slightly

oblique to the coiling axis. There are 10-12 ribs per 1 mm. Spiral striae are very inconspicuous. The aperture is not tilted to the coiling axis and is circular. The apertural rim is entire. The aperture is slightly shifted left against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, Peristomal margins are not sinuous. The inner peristome forms a narrow continuous polished callus. No specimens were available to study the internal lamellae. The operculum is derivative - circular, rather thick in lateral view, consists of several layers of concentric ridges and with medial impression on the inner surface.

Ecology: This species is known from primary lowland to mid montane rainforests and occurs in wet leaf litter on both limestone and granite soils. Reported from 100-2300 m altitude.

Distribution: Eastern New Guinea: Madang Province. Lake Sentani (northern New Guinea) record by van Benthem Jutting (1963) is likely based on misidentified specimen of *Palaina* sp. (this specimen was not available for my study).

Conservation status: Least Concern, LC. The current EOO is about 940 km² (Wiktor 1998 and earlier authors), but the maximum EOO is likely higher. The current AOO is 28 km², but the maximum AOO is definitively much higher. The population size and trend are unknown for *P. adelpha*, but this species is not uncommon. The population is not severely fragmented. This species is currently known from several localities and inhabits lowlands up to mid montane rainforests. Loss of the habitat considered the main threat. Between 2001 and 2014 about 78000 ha of the rainforest were lost in Madang Province (calculated for canopy



density over 25% according to the Global Forest Watch (2016)). Main reasons of deforestation are commercial logging (for international trade), forest conversion to oil palm plantations, expansion of gardens, as well as mining. Human population growth is not rampant but continuous slash and burn agriculture has negative impact on the AOO. Continuing decline in extent and quality of habitat for this species is estimated. But *P. adelpha* is under-researched and is not uncommon. There are at least three locations. Further research is required in order to clarify species distribution, population size, trend and better understand threats.

***Palaina* (s. l.) *aerari* (Dell, 1955) comb. nov.** (Plates 31 figs 13-15 & 40 figs 14-16, maps 11 & 19)
= *Palaina megamorpha* Solem, 1960 **syn. nov.** (Plate 40 figs 14-16)

Holotype *P. aerari* MONZ: M.202514, SOLI4403, Gardner, Norman 1944, Solomon Islands Treasury Islands Mono Island, ridge above Seveke River Leaf mould.

Holotype *P. megamorpha* UMMZ: FLW18 [printed] 200493 *Palaina megamorpha* Solem [handwritten] ½ Mi. from sea, behind Halavo, Florida Id., [printed] HOLOTYPE [handwritten] Solomons. Kuntz. 1944 MUSEUM OF ZOOLOGY UNIV. OF MICHIGAN [printed] / 200493 Holotype Diplommatinidae *Palaina megamorpha* Solem, 1960 Solomon Islands; Central; Florida Islands: Halavo Kuntz, R. E.; 1944: Dry; 1 University of Michigan Museum of Zoology Mollusk Division [printed, red border].

New combination: New combination is based on the conchological characters. There is a little denticle on the columellar side of the aperture in this species. This character is not supplemented by palatalis and parietalis and therefore this species not qualify as *Diplommatina*.

References *P. aerari*: Dell (1955: 423, 424), as *Diplommatina aerari*; Solem (1960: 49), as *Diplommatina aerari*; Clench (1965: 6), as *Diplommatina aerari*.

References *P. megamorpha*: Solem (1960: 50, 52, plate 6 fig. 1).

Measurements: Holotype *P. aerari* H = 3.9 mm, D = 2.2 mm, HW = 2.2 mm, PD = 1.6 mm. Holotype *P. megamorpha* H = 4.1 mm, D = 2.3 mm, HW = 2.3 mm, PD = 1.7 mm. Shell height of 4.51 mm given by Solem (1960) for holotype *P. megamorpha* is erroneous.

Description: Shell mid-sized to large, pink, creamy-coloured to brown, sinistral, high conical with conical apex. Shell with 5½-6¼ strongly convex whorls, the 1¾-1½ embryonic whorl is pitted. The suture is deeply impressed. The penultimate whorl is slightly bulbous. The ultimate whorl slightly

constricted, ascending, slightly narrower than or as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well delimited by a deep broad impression supplemented with a short zone of denser placed axial ribs. The suture is cavity-like impressed above the constriction. The constriction situated on same axis with the columellar side of the aperture. There is a very distinct bulb just beyond the constriction above the columellar side of the aperture. The teleoconch is sculptured with very coarse widely-spaced straight or almost straight ribs. The ribs becoming more widely-spaced on the last half whorl, but they are dense at the constriction. There are abrupt changes in the ribbing pattern - the axial ribs rapidly becoming widely-spaced on the early whorls than on the ultimate and the penultimate ones. The ribs are not synchronized with those of the previous whorls. The ribs are straight or slightly oblique to the coiling axis. There are about 12-15 ribs per 1 mm but 9-10 ribs per 1 mm on the last half whorl. Spiral striae are lacking in studied specimen. The aperture is not tilted against the coiling axis, is circular or oval. The apertural rim is entire. An angulation is developed on the palatal / parietal junction of the peristome in holotype *P. megamorpha*. The parietal margin of the aperture is nearly straight. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, narrow in lateral view. A very broad zone of numerous high axial sinuous lamellae prior to the peristome in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The columellar margin of the inner peristome is slightly sinuous. The inner peristome forms a continuous polished callus. The margins of the outer peristome are not or just slightly sinuous. A little columellar denticle is present, not directed downwards. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Specimens reported from leaf litter of lowland rainforest.

Distribution: Solomon Islands: Nggela (= Florida), Guadalcanal, Mono islands.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated over 3000 km². The maximum AOO for this species is estimated between 500 and 2000 km². No information is available on the population size and trend. Threats are unknown for this species. Further basic research is required in order to clarify species status in the wild, its distribution, measure the population size and highlight threats.



***Palaina* (s. l.) *albrechtii* sp. nov.** (Figs 39, 102, 107 & 137, plate 31 figs 7-12, map 27)
<http://zoobank.org/520A9B72-7454-4464-84C2-9BA4326455BF>

Holotype UF (No 508078): UF 380599 Mollusca, Diplommatinidae 17 specimen(s) *Palaina* [printed] sp. 6 [handwritten] Papua New Guinea, Sandaun Province Maibu, base of S slope of Mount Sapau, 4 km NW of Parkop Village, mature hill forest along river 550 meters -3.3945° 142.528° Slapcinsky, J. 23 May 2005 JS-0799 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / *Palaina* (micro!) JS-799 [handwritten].
Paratypes 8 adults, 2 subadults, 4 juv. UF & 1 adult KGC: same labels as holotype [one shell is broken].

Derivatio nominis: Patronymic. This species is devoted to my good friend, Dr. Christian Albrecht (Justus Liebig University, Giessen, Germany), an authority in phylogeny of freshwater gastropods.
Measurements: Holotype H = 1.3 mm, D = 0.75 mm, HW = 0.7 mm, PD = 0.6 mm. Selected paratype specimens: H = 1.25 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.55 mm; H = 1.2 mm, D = 0.75 mm, HW = 0.7 mm, PD = 0.6 mm; H = 1.1 mm, D = 0.7 mm, HW = 0.6 mm, PD = 0.5 mm.

Description: Shell very small, white to yellowish, sinistral, cylindrical with broadly conical apex. Shell with 5¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The protoconch is placed oblique on the rest of the shell. The suture is moderately deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short shallow impression and a

zone of slightly stronger sinuous axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight to hardly sinuous axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of previous whorls and are slightly oblique to the coiling axis. There are 17-19 ribs per 0.5 mm. Spiral striae are delicate and dense, good visible on almost all teleoconch whorls (there are 9 rows of spiral striae per 30 µm measured above the aperture). The aperture is not tilted from the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is triple, the palatal margin on the inner peristome is slightly sinuous. The inner peristome forms a continuous polished callus. The columella is smooth and shiny, broad internally and narrow medially, with an inconspicuous median angulation. The operculum is primitive - circular, transparent, with slightly elevated concentric lines.

Differential diagnosis: This species is similar to several minute Papuan *Palaina* species. It is primarily distinct due to very dense and rather delicate axial ribs supplemented with distinct and rather widely-spaced spiral striae. Specific characters are discussed in table 12.

Ecology: This species inhabits leaf litter of primary lowland rainforests and was collected at an altitude of 550 m.

Distribution: Northern New Guinea: Torricelli Mountains.

Table 12. Papuan species of *Palaina* s. l. similar to *P. albrechtii* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. albrechtii</i> sp. nov.
<i>Palaina beilanensis</i>	shell 2x higher than broad, H about 1.8-2 mm	shell less than 2x higher than broad, H about 1.1-1.3 mm
<i>P. insulana</i> sp. nov.	shell H about 1.8-1.95 mm, peristome rather broad in lateral view, triple and consists of several dense lamellae	shell H about 1.1-1.3 mm, peristome thin in lateral view and consists of a few lamellae
<i>P. biroi</i>	operculum with low concentric ridges and shallow median impression on the outer surface, 5 rows of spiral striae per 30 µm (measured above the aperture)	operculum without concentric ridges and without median impression, 9 rows of spiral striae per 30 µm (measured above the aperture),
<i>P. iha</i> sp. nov.	a short zone free of axial ribs at the constriction, shell H about 1.35-1.4 mm	no interruption in ribbing pattern at the constriction, shell H about 1.1-1.3 mm
<i>P. lengguru</i> sp. nov.	abrupt changes of the axial ribbing pattern - starting from the constriction ribs getting coarser, twice more distantly spaced	axial ribbing pattern changes evenly starting from the constriction
<i>P. waigeo</i> sp. nov.	abrupt changes of the axial ribbing pattern - starting from the constriction ribs becoming coarser, twice more distantly spaced	axial ribbing pattern changes evenly starting from the constriction



Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO since this species is known from single locality. The maximum EOO likely includes large area in Torricelli Mountains. The current AOO is 4 km², maximum AOO is likely higher. Population size and trend are unknown, but *Palaina albrechti* sp. nov. seems not abundant. The main threat for this species cannot be identified. Further research is required on distribution, population size, trend and threats for this species.

***Palaina* (s. l.) *angulata* O. Boettger, 1891** (Figs 40-42, 99a-b, 114, plate 32 figs 1-13, map 8)

Lectotype SMF: *Palaina angulata* Bttgr. Batu merah, Leitimor, S. Amboina. × Ad. Strubell 90. [handwritten] / Senckenberg.Mus. [printed] 105070/01 [handwritten] Frankfurt-M. [printed] *Palaina angulata* O.Boettger Lectotypus! 1891 T.4 F.4 Molukken: Batu merah, Leitimor (S.Amboina) A.Strubell 1890 [handwritten] Sammlung O.Boettger [printed].

Paralectotype 1 adult SMF: *Palaina angulata* Bttg. Kusu-Kusu (Sereh) auf Leitimor, N. Amboina. x A.Strubell 91. [handwritten] / Senckenbg.Mus. [printed] 105071/1 [handwritten] Frankfurt-M. [printed] *Palaina angulata* O. Boettger Paratypus Molukken: Kusu-Kusu (Sereh), Leitimor (N-Amboina) A. Strubell 1891 [handwritten] Sammlung O.Boettger [printed].

Additional material: 5 adults NME & 5 adults KGC: INDONESIA E, Prov. Maluku tengah, Lease Islands, Saparua, kota Saparua ~1,5 km NE, 03°33'31"S, 128°39'50"E, 11.IV.2009, secondary lowland forest & shrubs, leg. D.Telnov; 3 adults & 2 juv. KGC: INDONESIA E, Central Moluccas, Lease Islands, southern arm of Ambon Is., Ambon (kota) 5 km E, Soya vill. ~1 km E, 03°42'36"S, 128°13'16"E, 17.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner; 1 adult KGC: INDONESIA E, Central Moluccas, Lease Islands, northern arm of Ambon Is., Waai 4 km NW, 03°32'56"S, 128°17'17"E, 300 m, 19.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner.

References: Boettger O. (1891: 286, pl. 4 fig. 4); Kobelt & von Möllendorff (1898: 152), checklist, as *Palaina* Subgen. *Palaina* s. str. *angulata*; Kobelt (1902: 394); Boettger C.R. (1908: 184), as *Palaina* (*Eupalaina*) *angulata*; van Benthem Jutting (1953: 287); Zilch (1953: 9, pl. 5 fig. 60), as *Palaina* (*Palaina*) *angulata*; Monk et al. (1997: 395).

Measurements: Paralectotype H = 2.5 mm, D = 1.55 mm, HW = 1.3 mm, PD = 1.1 mm. Selected specimens from Soya vill. env., Ambon Is.: H = 2.8 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1.3 mm; H = 2.7 mm, D = 1.75 mm, HW = 1.45 mm, PD = 1.3 mm. Selected specimens from Saparua Is.: H = 2.4 mm, D = 1.3 mm, PD = 1 mm; H = 2.3 mm, D = 1.4

mm, PD = 1 mm.

Description: Shell is small, whitish to yellowish, prevalently dextral but also sinistral specimens are known (from Saparua Island), cylindrical with conical apex. Shell with 6¼–6½ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is slightly constricted, almost as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is delimited by a flat impression, and the suture is deeper impressed above the constriction. Additionally, a short zone of denser placed axial ribs (in certain specimens, see below) is present at the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with rather coarse, dense or widely-spaced, straight or slightly sinuous axial ribs. There are no abrupt changes in the ribbing pattern in specimens from Ambon Island. In specimens from Saparua Island the axial ribs becoming much denser at the constriction. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 4-6 ribs per 0.5 mm. The ribs are widely-spaced on the last half whorl. Spiral striae are distinct and dense. There are 2-3 (in specimens from Ambon) to 4-5 (in specimens from Saparua) rows of spiral striae per 30 µm (measured above the aperture). The aperture is not tilted to the coiling axis and is circular or oval and has entire apertural rim. The position of the aperture is more or less central below the coiling axis or the aperture is slightly shifted to the right in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The margins of the inner peristome are not sinuous. The palatal margin of the outer peristome is slightly sinuous. The basal margin of the outer peristome is somewhat reflexed. The columellar margin of the outer peristome is sinuous, widening into an obtuse angular protruding (which is less conspicuous in certain Saparua specimens). The columella is shiny and broad with glass-like semitransparent inner edge. The operculum is derivative - circular, with concentric ridges on the outer surface.

Phylogeny: According to results of Ambon specimens' COI analysis this species represents a separate clade of *Palaina* species from the Lesser Sunda Islands (*P. manggaraica* (B. Rensch, 1931) and Lease Islands (*P. ascendens* (Martens, 1864) (see section "Phylogeny").

Ecology: *P. angulata* inhabits both primary and secondary lowland rainforests on limestone soils, as well as closed canopy gardens. This species is



recorded from up to 1000 m altitude. Specimens occur in wet leaf litter on the undersides of fallen leaves and under pieces of decaying wood.

Distribution: Lease Islands (Central Moluccas): Ambon Island, Haruku Island, Saparua Island.

Conservation status: Endangered, EN B1aB2a-b(ii,iii). The current EOO is about 220 km², but the maximum EOO is estimated 1700 km² taking into account the area of Ambon, Haruku and Saparua. The current AOO is about 28 km², but the maximum AOO estimated higher but probably not extends 500 km². The population size and trend are unknown however *P. angulata* is not uncommon. The population is not severely fragmented. This species is currently known from several localities and inhabits lowland rainforests with preference to those on limestone soils. Habitat loss considered the main threat. Deforestation drivers are forest conversion to gardens, timber use for building construction and collecting of firewood. Human population growth is rampant on Lease Islands and the population density is high. Continuing decline in extent and quality of habitat is documented and projected for *P. angulata*. Decline in AOO is documented for Ambon. *P. angulata* is also found in disturbed forests with partially closed canopy, and this species survived in gardens on Saparua Island. There are at least 4 locations. There are no nature conservation areas on Lease Islands and *P. angulata* population is not protected. Further research is required on distribution of this species and on the population size. Establishing nature conservation area to protect remaining old-growth forests on Haruku and Ambon is highly recommended.

***Palaina* (s. l.) *ascendens* (Martens, 1864)** (Fig. 43, plate 31 figs 16-20, map 9)

Lectotype MHUB [herewith designated]: Amboine [handwritten] / Diplomatina [sic!] 6270. Pupa * ascendens Martens Amboina vMartens [handwritten] / Anostomella [handwritten] / Zoolog. Museum Berlin [printed] Anostomella Pupa [original correction] ascendens (Marts.)* Amboina 6270 Martens [handwritten].

Paralectotype 1 adult MHUB [herewith designated]: same labels as lectotype [shell is broken].

Additional material 19 adults 1 juv KGC, 1 adult NME & 1 adult SNSD: INDONESIA E, Prov. Maluku tengah, Lease Islands, Saparua, kota Saparua ~1,5 km NE, 03°33'31"S, 128°39'50"E, 11.IV.2009, secondary lowland forest & shrubs, leg. D.Telnov; 1 juv. KGC: INDONESIA E, Central Moluccas, Lease Islands, southern arm of Ambon Is., Ambon (kota) 5 km E, Soya vill ~1 km E, 03°42'36"S, 128°13'16"E, 17.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner; 1 adult, 1 subadult & 3 juv. KGC: INDONESIA E, Central Moluccas, Lease Islands, Haruku Is., Pelauw vill. 3.3 km S,

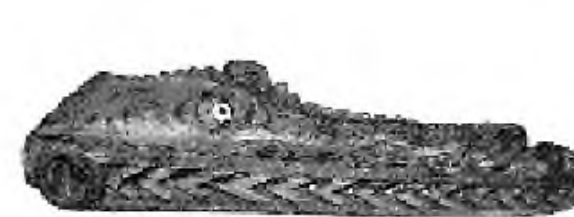
03°32'30"S, 128°27'15"E, 150-170 m, 18.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner.

Note: Consider synonymy of *Anostomella* with *Palaina* above.

References: Martens (1864b: 528), as *Pupa ascendens*; Martens (1867: 386, pl. 22 fig 23); Ancey (1887: 279), as *Diancta (Anostomella) ascendens*; Tenison-Woods (1888: 1054), as *Pupa ascendens*; Kobelt & von Möllendorff (1898: 135), checklist; Boettger O. (1891: 287); Kobelt (1902: 422); Thiele (1929: 110); Wenz (1938: 483); van Benthem Jutting (1953: 287, 312-313); Monk et al. (1997: 395); Egorov (2013: 22).

Measurements: Lectotype H = 3.9 mm, D = 3.1 mm, HW = 1.9 mm, PD = 1.7 mm. Selected specimens from Saparua Island: H = 3.8 mm, D = 2.8 mm, HW = 1.95 mm, PD = 1.55 mm; H = 3.5 mm, D = 2.8 mm, HW = 1.9 mm, PD = 1.6 mm; H = 3.65 mm, D = 2.8 mm, HW = 1.95 mm, PD = 1.6 mm.

Description: Shell is large, whitish to pale orange or pale brown, dextral, very obese and broadly oval with a shortly conical apex. Shell with 6¼ slightly convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is constricted and ascending, by apertural view, narrower than the penultimate whorl. The umbilicus is closed in adults by the ascending tuba. The constriction is well delimited by the suture cavity-like strongly impressed above the constriction and by the ribs abruptly becoming dense and delicate. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, dense, and inconspicuously sinuous ribs. The ribs are partly synchronized with those of the previous whorls. The ribs are oblique to the coiling axis and there are 8-9 ribs per 1 mm. The ribs becoming dense in front of the ultimate whorl prior to the constriction and become more widely-spaced beyond the constriction. Spiral striae are lacking. The aperture ascends as the ultimate whorl is. The aperture is slightly oval, its maximum diameter is when measured from parietal to basal side and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The peristome is indistinctly double. The palatal and columellar margins of both the inner and outer peristomes are somewhat sinuous. The inner peristome forms a continuous polished callus. The parietal margin of the peristome is attached to the ultimate whorl. The columella is very broad and smooth with a large triangular median knob which is directed backwards. The columella is visible in the aperture in a form of a flat broad cal-



lus. The operculum is primitive - circular and concave on the outer surface.

Phylogeny: According to results of Ambon and Haruku specimens' COI analysis this species represents a separate clade of *Palaina* from the Lesser Sunda (*P. manggaraica* (B. Rensch, 1931) and Lease Islands (*P. angulata* O. Boettger, 1891) (see chapter "Phylogeny").

Ecology: This species known from primary and secondary lowland rainforests on limestone soil as well as from closed-canopy gardens. Specimens found under leaf litter.

Distribution: Lease Islands (Central Moluccas): Ambon, Haruku, Saparua.

Conservation status: Endangered, EN B2ab(ii,iii). *Palaina ascendens* is endemic to Central Moluccas and hitherto known from three of four main Lease Islands. Its presence on Seram Island is projected on areas with limestone soils. The current EOO is about 600 km², but maximum EOO estimated up to 200000 km². The current AOO is 28 km², but maximum AOO estimated much higher, but certainly less than 500 km². *P. ascendens* inhabits lowland rainforests, as well as wet closed canopy gardens. Population size and trends are unknown, but at least on Saparua this species is not uncommon in suitable habitat. Habitat loss is the main threat for *P. ascendens*. The area of occupancy is under constant pressure due to growing human population, expansion of human settlements and factories, wood consumption for various purposes and conversion of rainforest into gardens and plantations. Population is threatened by limestone mining for road and building construction. These threats are likely to continue on a larger scale as a result of population growth. Further decline in potential AOO is projected. Rainforests only remain in difficult to access mountains in this region, *P. ascendens* survive on Lease Islands in forest remnants and gardens. Further research is needed to clarify population size and trend for this species. Establishing nature conservation areas to protect remaining old-growth forests on Haruku and Ambon is highly recommended.

***Palaina* (s. l.) *attenboroughi* sp. nov.** (Figs 44-45, 117, plate 32 figs 14-23, map 18)

<http://zoobank.org/A9E64F72-C826-4226-8E64-8BE0D34B43DD>

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 100-350 m, 06.II.2012, primary lowland rainforest, limestone rocks, leg. D.Telnov.

Paratypes 74 specimens: 23 adults & 4 juv. KGC, 3 subadults & 3 juv. NME: same label as holotype; 10 adults KGC, 5 adults NME: INDONESIA E, Prov. Raja Ampat, distr. Misool Barat, Lilinta (Lelintah) vill. ~13,5 km NW, Gamta vill. ~11 km NWW, River Gam valley in the middle of course, 01°57'49"S, 130°11'10"E, 03.IV.2009, primary lowland rainforest, leg. K.Greke; 12 adults KGC, 10 adults & 1 juv. NME, 2 LKCNHM & 1 SMF: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: Patronymic. With pleasure I name this species in honour of Sir David Frederick Attenborough (London, United Kingdom), the famous British naturalist and broadcaster, who devoted most of his life nature conservation through education.

Measurements: Holotype: H = 3.3 mm, D = 1.9 mm, HW = 1.4 mm, PD = 1.4 mm. Selected paratype specimens: H = 3.3 mm, D = 2 mm, HW = 1.4 mm, PD = 1.4 mm; H = 3.2 mm, D = 1.9 mm, HW = 1.3 mm, PD = 1.3 mm; H = 3.2 mm, D = 1.7 mm, HW = 1.2 mm, PD = 1.3 mm; H = 3.1 mm, D = 1.6 mm, HW = 1.3 mm, PD = 1.3 mm; H = 3.1 mm, D = 1.7 mm, HW = 1.3 mm, PD = 1.35 mm; H = 2.8 mm, D = 1.4 mm, HW = 1.1 mm, PD = 0.9 mm.

Description: Shell is small, white with yellow 2-4 first whorls, sinistral, narrow and high conical. Shell with 8 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is strongly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a shallow broad impression and a short zone of somewhat sparser axial ribs. The constriction situated on same axis with the palatal side of the aperture or is centered (in apertural view). The teleoconch is sculptured with coarse widely-spaced strong and slightly sinuous axial lamellae-like ribs. The ribs are bending counter-clockwise near and in the suture. The ribs becoming very distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 4 ribs per 0.5 mm. Spiral striae very delicate and dense. The aperture is not tilted to the coiling axis and is circular or oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl or aperture is slightly shifted left in apertural view. The peristome is double, very broad and expanded (but can be not fully developed in certain adult specimens). The parietal



margin of the peristome is attached to the ultimate whorl. Laterally the peristome consists of numerous dense lamellae. The inner peristome forms a continuous polished callus. The palatal margins of both peristomes are slightly sinuous. The columella is broad and shiny, slightly twisted medially. The operculum is derivative - thick in lateral view, consists of several layers of concentric ridges and with a broad, spatula-like median "handler" on the inner surface.

Differential diagnosis: Most closely related with *Palaina dohertyi* E.A. Smith, 1897 (West New Guinea: Onin Peninsula) but differs from it in higher shell, less high and not humped axial ribs, the penultimate whorl being higher (less high in *P. dohertyi*) and the columella is lacking median knob (knob is present in *P. dohertyi*).

Phylogeny: According to results of COI analysis this species represents a separate clade most related with Misool species *P. bicornis* van Benthem Jutting, 1958 which again represents a different but related clade.

Ecology: Primary lowland rainforests on limestone soils. Specimens occur in leaf litter on the undersides of fallen leaves and under pieces of decaying wood. Specimens sampled at altitudes 70-350 m, found both at base of limestone rocks in very moist conditions and at the very top of limestone ridges where the substrate is dry because of good drainage.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Least Concern, LC. Not enough data available to calculate the current EOO. The maximum EOO is estimated about 2000 km² taking into account the area of Misool Island and available habitat. The current AOO is 4 km². The maximum AOO is likely much higher. No information is available on the population size and trend, however *P. attenboroughi* sp. nov. is locally common in central Misool. This species is currently known from one locality and inhabits primary lowland rainforests on limestone soils. No threats to this species have been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing, especially because of establishing new administrative divisions on this island (in order to raise extra funding). Hitherto no large scale deforestation recorded on Misool, but some areas (for example near Lilinta vill. in the SE) suffered from small-scale illegal logging over a decade ago. Significant decline in EOO, AOO or quality of habitat cannot be projected for this species within next 10 years. Further research is required

on distribution and ecological preferences of this species.

***Palaina* (s. l.) *beilanensis* Preston, 1913** (Plate 32
figs 24-27, map 6)

Syntypes: 1 adult BMNH: *Palaina beilanensis* Pre[ston] Beilan - Beilan Isl. Moluccas. 1914.1.7.461 [handwritten] / Type. [printed] / *beilanensis* Preston. Dutch. E. Indies. [handwritten] [shell is badly broken]; 2 adults FMNH: 72965 [printed] / 72965 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 2 dry specs. Syntype(s): *Palaina beilanensis* Preston, 1913 Sta. FMNH72965, Indonesia, Moluccas, N of Obi, Beilan Beilan ex F.F. Laidlaw ex H.B. Preston (Acc.# 11666) [printed].

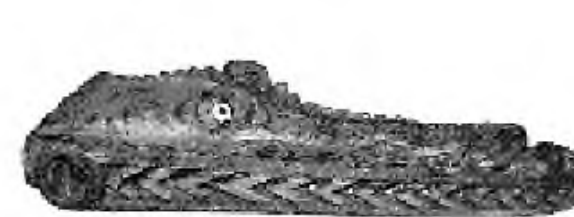
Additional material 1 adult MHUB: Zoolog. Museum Berlin. [printed] *Palaina beilanensis* Prest. Ind. of Beilan-Beilan Moluccen [sic!] 63785 Preston [handwritten] / 63785 [handwritten].

References: Preston (1913: 438).

Measurements: Specimen from MHUB H = 1.8 mm, D = 0.85 mm, HW = 1.1 mm, PD = 0.7 mm. Selected syntype from FMNH: H = 1.9 mm, D = 0.85 mm, HW = 0.9 mm, PD = 0.65 mm.

Description: Shell is very small, whitish, sinistral, narrow cylindrical with flattened apex. Shell with 5½ rather flat whorls, the 1⅓ embryonic whorl is microgranulate. The suture is moderately deeply impressed. The ultimate whorl is slightly narrower than or as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a very shallow impression and a short zone of stronger sinuous axial ribs. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with fine, dense, straight to slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 15 ribs per 0.5 mm. The ribs becoming somewhat coarser and more widely-spaced on the ultimate whorl. Spiral striae are very delicate and dense. The aperture is tilted about 10° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is triple, Peristomal margins are not sinuous. The inner peristome forms a continuous polished callus. No specimens were available to study the internal lamellae. The operculum is primitive - circular, without concentric ridges.

Ecology: Unknown. Belangbelang Island is cov-



ered by primary lowland rainforest on limestone soils.

Distribution: Southernmost North Moluccas: Belangbelang Island of Obi Islands group. Almost certainly should be found on other islands of Obi group, particularly on limestone Obilatu Island.

Conservation status: Data Deficient, DD. *Palaina beilanensis* is known by series of specimens collected over 100 years ago from single locality. Not enough data available to calculate current EOO and AOO. The area of Belangbelang Island is 7 km². The total area of all Obi Islands is about 5100 km². It is very unlikely *P. beilanensis* occurs all over Obi Islands (especially not on distant Gomumu and Tobalai) and only small fractions of Obi rainforests known to be located on limestone soil. The current EOO is unknown. Consequently, the maximum EOO for this species is certainly below 5000 km². Habitat loss considered the main threat. Belangbelang Island is uninhabited, but all neighbouring islands (small Bisa, Obilatu, Tapat and large Obira) are inhabited. The area of Obi Islands covered by rainforest is decreasing consequently; between 2001 and 2014 about 11000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Considering human population growth on Obi Islands and presence of large nickel mine in the W of Obira Island (which attract workers from other regions of Indonesia), this trend is likely to continue. Malacological research on Obira Island carried out by the University of Florida (2008), as well as on Bisa and Obira islands by the Entomological Society of Latvia (2011, 2013) gave no result for this species. The population of *P. beilanensis* is likely small or restricted to Belangbelang and, possibly, Obilatu and Tapat islands. Additional research is required on Belangbelang to clarify status of this species in the wild and estimate size and trend of the population. Further search for *P. beilanensis* distribution to be performed on Obilatu and Tapat islands.

***Palaina* (s. l.) *bicornis* van Benthem Jutting, 1958**

(Figs 46-47, plate 33 figs 1-12, map 18)

Holotype NMNL: Indonesia, Papua, Misoöl, Waima, 0-75 m, Lieftinck, M.A. 1948.09.13 [printed].

Additional material: 10 adults & 6 juv. NME, 10 adults, 3 subadults & 10 juv. KGC: INDONESIA E, Prov. Raja Ampat, distr. Misool Barat, Lilinta (Lelintah) vill. ~13,5 km NW, Gamta vill. ~11 km NWW, River Gam valley in the middle of course, 01°57'49"S, 130°11'10"E, 03.IV.2009, primary lowland rainforest, leaf litter, leg. K.Greke; 3 adults & 2 subadults KGC, 1 adult, 2 subadults & 6 juv. NME: INDONESIA E, Raja Ampat, Misool Island S, Lilinta (Lelintah) vill. env., 02°02'57"S,

130°15'58"E, 6 m, 02-03.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 15 adults KGC, 7 adults, 4 subadults & 7 juv. NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

References: van Benthem Jutting (1958a: 295, 316); van Benthem Jutting (1963: 702).

Measurements: Paratype H = 2.4 mm, D = 1.8 mm, HW = 1.4 mm, PD = 1.1 mm. Selected specimens from River Gam valley, central Misool: H = 2.1 mm, D = 1.5 mm, HW = 1.2 mm, PD = 0.7 mm; H = 2.5 mm, D = 1.65 mm, HW = 1.3 mm, PD = 1.2 mm.

Description: Shell is small with very thick wall, whitish, yellowish or greenish, sinistral, broadly fusiform with conical apex. Shell with 6 strongly convex whorls, the 1½-2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The penultimate whorl is slightly bulbous. The ultimate whorl is constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short and shallow impression, a short zone of denser and stronger sinuous axial ribs and presence of a deep cavity-like impression on the suture above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with very delicate, dense, straight to slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 6-8 ribs per 0.5 mm. The ribs becoming more widely-spaced and coarse on the last half whorl. Spiral striae are poorly indicated, very delicate and dense, only visible on the ultimate whorl. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The outer peristome is thick in lateral view, provided with an obtuse protrudings at the parietal / palatal and columellar / parietal junctions. The palatal margin of the outer peristome is sinuous. The columella is smooth and thin. The operculum is derivative - thin in lateral view, transparent, in a form of a flying disc with raised margin, large handle-like median protruding on the inner surface, without concentric



ridges or lines.

Phylogeny: According to results of COI analysis this species represents a separate clade most related with Misool species *P. attenboroughi* sp. nov. which represents a near-standing clade.

Ecology: This species is known from primary lowland rainforests on limestone soils and occurs in wet leaf litter, under decaying wood and in cavities on limestone rocks. Specimens aggregate in number on the underside of large fallen leaves and were not observed under small leaves. Reported from near sea level up to 450 m altitude.

Distribution: Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. The current EOO is about 160 km². The maximum EOO estimated more than 10000 km² taking into account the area of Misool Island and available habitat. The current AOO is 12 km². The maximum AOO is likely much higher. No information is available on the population size and trend, however *P. bicornis* is one of the most common Diplommatinidae species in central part of Misool. This species is currently known from several localities and inhabits old-growth lowland rainforests on limestone soils. The population is not severely fragmented. No major threat has been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing especially because of establishing new administrative divisions on this island (in order to attract funding). Hitherto no large scale deforestation recorded on Misool, but some areas (for example near Lilinta vill. in the SE) suffered from illegal logging over a decade ago. Significant decline in EOO, AOO or quality of habitat cannot be projected for this species within next 10 years. Further research is required to highlight threats for *P. bicornis*.

***Palaina* (s. l.) *biroi* Soós, 1911** (Figs 48 & 118, plate 33 figs 13-27, map 27)

Lectotype NMNL: Friedrich-Wilhelmshafen, Biró 1901. Additional material: 42 adults & 3 juv. UWCP: Museum of Nat. Hist., Wroclaw Papua-New Guinea, Prov. Madang Balek ca 15 km SW of Madang by the road to Lae. In primeval rain forest on the cliff, limestone. ca. 100 m a.s.l. Leg. A.Wiktor 6.10.1990 No. 2531 [printed] / *Palaina biroi* Soós, 1911 Det.A.Wiktor 1996 [printed] / 2531 Balek 6 X [handwritten]; 3 adults: Museum of Nat. Hist., Wroclaw Papua-New Guinea, Prov. Madang Nabanab Mission ca 15 km NW of Madang, near village in destroyed forest ca 380 m a.s.l. Leg. A.Wiktor 10.10.1990 No. 2535 [printed] / *Palaina biroi* Soós, 1911 Det.A.Wiktor 1996 [printed]; 8 adults & 2 juv.: Museum of Nat. Hist., Wroclaw Papua-New Guinea, Prov.

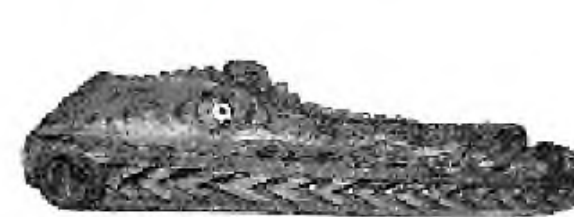
Madang in mangrove near Riwo vill. /N of Madang/. Leg. A.Wiktor 15.10.1990 No. 2546 [printed] / *Palaina biroi* Soós, 1911 Det.A.Wiktor 1996 [printed]; 18 adults & 1 juv.: Museum of Nat. Hist., Wroclaw Papua-New Guinea, Prov. Madang Balek ca 15 km SW of Madang by the road Madang-Lae in primeval rain forest, on the cliff and between the caves, limestone ca. 100 m a.s.l. Leg. A.Wiktor 12.11.1990 No. 2584 [printed] / *Palaina biroi* Soós, 1911 Det.A.Wiktor 1996 [printed] / 2584 [handwritten]; 2 adults: Museum of Nat. Hist., Wroclaw Papua-New Guinea, Prov. Madang near Korog vill., ca 200 m a.s.l. Leg. A.Wiktor 26.11.1990 No. 2600 [printed] / *Palaina biroi* Soós, 1911 Det.A.Wiktor 1996 [printed] / 2600 26XI Korog [handwritten]; 46 adults & 4 juv. UF, 4 adults KGC: UF 476278 Mollusca, Diplommatinidae 1-spec. [sic! over 50 specimens available] *Palaina* Papua New Guinea, Madang Province, Rempi Mission, Sempi River 36 meters -5.0104° 145.7839° 9 Nov 2012, PNG12-0320, PM14 John Slapcinsky 75% ethanol 476278 DNA SUBSAMPLE ONLY FLORIDA MUSEUM OF NATURAL HISTORY / PNG12-0320; 15 adults & 2 juv. UF: UF 476300 Mollusca, Diplommatinidae 19-spec. [sic! only 17 specimens available] *Palaina* Papua New Guinea, Madang Province Mototua -5.0755° 145.7734° 15 Nov 2012, PNG12-0646, PM23 John Slapcinsky 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY / PNG12-0646; 1 adult UF: UF 475831 Mollusca, Diplommatinidae 1-spec. *Palaina* Papua New Guinea, Madang Province, Rempi Area, S Ululan -5.0093° 145.7708° 19 Nov 2012, PM31 John Slapcinsky dry FLORIDA MUSEUM OF NATURAL HISTORY.

Note: Soós' type collection was lost in the fire at the Hungarian Natural History Museum. Redescription is based on the lectotype from NMNL and on comparative specimens collected from the type locality by Wiktor (1998).

References: Soós (1911: 348); Leschke (1912a: 145); van Benthem Jutting (1963: 702); Wiktor (1998: 17).

Measurements: Selected specimens from Madang Province (UWCP): H = 1.6 mm, D = 0.85 mm, PD = 0.7 mm; H = 1.6 mm, D = 0.9 mm, PD = 0.6 mm; H = 1.6 mm, D = 0.9 mm, PD = 0.7 mm; H = 1.5 mm, D = 0.85 mm, PD = 0.6 mm; H = 1.5 mm, D = 0.8 mm, PD = 0.65 mm; H = 1.4 mm, D = 0.8 mm, PD = 0.6 mm; H = 1.4 mm, D = 0.8 mm, PD = 0.65 mm; H = 1.3 mm, D = 0.75 mm, PD = 0.5 mm. Selected specimen from Rempi Area (UF) H = 1.3 mm, D = 0.8 mm, HW = 0.75 mm, PD = 0.6 mm.

Description: Shell is very small, whitish, creamy, yellowish or strong yellow, sinistral, cylindrical with broadly conical apex. Shell with 5-5½ convex whorls, the 1½ embryonic whorl is microscopically pitted. Pits are arranged in axial rows. The protoconch is placed oblique on the rest of the shell. The suture



is moderately deeply impressed. The ultimate whorl as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a shallow impression and (in certain specimens) much sparser axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with relatively fine dense sinuous ribs. In certain specimens the ribs becoming very widely-spaced (up to 4x) above the aperture, which is not the case in the lectotype. There are abrupt changes in the ribbing pattern at the constriction area. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 12-16 ribs per 0.5 mm. Spiral striae are extremely delicate, partly not indicated but dense when indicated. At 300x magnification there are 5 rows of spiral striae per 30 µm measured above the aperture. The aperture is not or tilted about 10° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double or triple, all margins are not sinuous or all palatal margins are slightly sinuous. The inner peristome forms a continuous polished callus. The columella is smooth and shiny, broad in upper part and narrowed towards base, provided with an obtuse median angulation. The operculum is derivative - circular, transparent, with slightly elevated concentric lines and very shallowly medially impressed on the outer surface.

Ecology: This species inhabits primary and secondary lowland to upper montane rainforests and occurs in wet leaf litter on limestone and granite soil. Reported from altitudes 60-3300 m.

Distribution: Eastern New Guinea: provinces Chimbu and Madang. Record from Doberai Peninsula (near Manokwari) in western New Guinea by van Benthem Jutting (1963) is very dubious and is likely based on misidentified specimen (which was not available for my study).

Conservation status: Least Concern, LC. The current EOO is about 2700 km², but the maximum EOO estimated higher. The current AOO is 40 km², but the maximum AOO is likely much higher. No information is available on the population size and trend. However, *P. biroi* is rather common species widespread in Madang Province and adjacent part of Chimbu. This species is known from several localities and inhabits lowland and mid montane rainforests. The population is not severely fragmented. Habitat loss is the main threat. Between 2001 and 2014 about 78000 ha of the rainforest were lost

in Madang Province (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Deforestation reasons are commercial logging for international trade, expansion of oil palm plantations and gardens as well as mining. Human population growth is not rampant but continuous slash and burn agriculture has negative impact on the AOO. Continuing decline in extent and quality of habitat for this species is estimated. But since *P. biroi* is widespread, common from mangrove swamps to the mid montane rainforests, no continuous decline in EOO or AOO is projected. There are at least 4 locations. Further research is required on ecology of this species as well as on the population size and trend.

***Palaina* (s. l.) *bougainvillei* sp. nov.** (Fig. 49, plate 34 figs 1-8, map 19)

<http://zoobank.org/45C1B9AD-08E9-4767-B798-BA4EE4BA6862>

Holotype UF (No 508077): UF 475819 Mollusca, Diplommatinidae 22-spec. *Palaina* Papua New Guinea, Bougainville Province Bougainville Island, Kokopo overgrown coconut plantation -5.4303° 154.6853° 5 Dec 2012, JDS-1287 John Slapcinsky, Cindy Bick dry FLORIDA MUSEUM OF NATURAL HISTOR [sic!] / Mollusca 475819.

Paratypes 101 specimens: 12 adults 1 subadult & 5 juv. UF, 3 adults KGC: same labels as holotype [1 adult shell is badly broken]; 50 adults & 12 juv. UF, 6 adults KGC: UF 475781 Mollusca, Diplommatinidae 50-spec. *Palaina* Papua New Guinea, Bougainville Province Bougainville Island, Kokopo overgrown coconut plantation -5.4303° 154.6853° 5 Dec 2012, JDS-1287 John Slapcinsky, Cindy Bick 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JDS 1287 [handwritten]; 9 adults & 1 juv. UF, 2 adults KGC: UF 476386 Mollusca, Diplommatinidae 10-spec. *Palaina* Papua New Guinea, Bougainville Province Buka Island, 5 km SW of Suhin Village -5.2265° 154.6781° 6 Dec 2012, PNG12-3249, JDS-1289 John Slapcinsky, Cindy Bick 75% ethanol 476386 DNA subsample FLORIDA MUSEUM OF NATURAL HISTORY [printed] / PNG12-3249 [printed] / 1289 [handwritten].

Derivatio nominis: Toponymic. This species is named after Bougainville, a group of Papua New Guinean islands in the north of the Solomon Archipelago.

Measurements: Holotype H = 2.8 mm, D = 1.5 mm, HW = 1.45 mm, PD = 1.15 mm. Selected paratype specimens from Bougainville Island: H = 2.9 mm, D = 1.5 mm, HW = 1.5 mm, PD = 1.15 mm; H = 2.9 mm, D = 1.6 mm, HW = 1.4 mm, PD = 1.2 mm; H = 2.75 mm, D = 1.4 mm, HW = 1.4 mm, PD = 1.15 mm; H = 2.6 mm, D = 1.5 mm, HW = 1.5



mm, PD = 1.2 mm. Selected paratypic specimens from Buka Island: H = 3 mm, D = 1.6 mm, HW = 1.7 mm, PD = 1.3 mm; H = 2.7 mm, D = 1.4 mm, HW = 1.4 mm, PD = 1.2 mm; H = 2.7 mm, D = 1.4 mm, HW = 1.5 mm, PD = 1.1 mm.

Description: Shell is small, pale brown, sinistral, conical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is slightly ascending, it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well delimited by a short deep impression supplemented with an angulate bulb just beyond the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate, dense, straight ribs. The ribs becoming coarser and 2-2.5x more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 11-12 ribs per 0.5 mm. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick in lateral view and consists of numerous dense lamellae. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus. Peristomal margins are not sinuous or the palatal margin of the outer peristome is slightly sinuous. The columella is smooth and shiny, twisted in basal third and then turned down, forming 7-like columellaris which is visible in the aperture (in certain specimens) in a form of an inconspicuous denticle. The operculum is derivative, in a form of a flying disc, with raised margin and with few concentric lines, provided with short and broad C-like median “handler” on the inner surface.

Differential diagnosis: This species is peculiar in shape of the columella and its 7-like twisted columellaris (which is visible in the aperture), in very dense axial ribs on the ultimate whorl and due presence of distinctly angulate bulb. The aperture of *Palaina aerari* (Dell, 1955) (Solomon Islands: Nggela, Guadalcanal, Mono) also provided with an inconspicuous columellar callus and an angulate bulb is present on the ultimate whorl in both species. *P. aerari* is larger (3.9 mm compared with 2.6-3 mm in *P. bougainvillei* sp. nov.), axial ribs are much more distant on early teleoconch whorls than on the penultimate and the ultimate ones (in

contrast, there are no abrupt changes in axial ribbing pattern in *P. bougainvillei* sp. nov., see plate 31 figs 13-15 & plate 34 figs 1-3) and the penultimate whorl (in apertural view) is somewhat bulbous in *P. aerari* but not in *P. bougainvillei* sp. nov.

Ecology: Specimens found in coconut plantation overgrown by secondary rainforest vegetation as well as in much degraded lowland rainforest, in leaf litter.

Distribution: Solomon Islands archipelago: Bougainville Island, Buka Island.

Conservation status: Data Deficient, DD. This species is known from two localities. Currently not enough data available to calculate current EOO. The current AOO is 8 km² but the maximum AOO is likely much higher. The population size and trend are unknown, but *Palaina bougainvillei* sp. nov. is rather abundant in lowland coastal areas of Buka and NW Bougainville. Since this species also inhabits very disturbed vegetation, its population is likely not dramatically affected by deforestation and primary rainforest conversion into gardens. Further research is required in order to clarify distribution, measure population size and highlight threats for this species.

***Palaina* (s. l.) *brazieri* (Cox, 1870)** (Plate 34 figs 9-12, map 11)

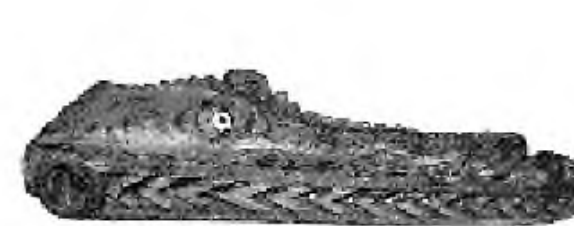
Material 1 adult MCZ: *Palaina brazieri* Cox 251224 Kira Kira San Cristoval Solomon Islands Whitney Exp. [handwritten] / Am. MUS. NAT. HIST. [printed] acc. 503 251224 [handwritten] / Mus.Comp.Zoöl., Cambridge, Mass. No. [printed] 251224 *Palaina brazieri* Cox Kira Kira San Cristoval, Solomon Ids. Whitney exped. [handwritten] Ex. A.M.N.H. Acc. 502 [printed].

Note: Type specimens of this species in the Linnean Society NSW were lost by the great fire of the Garden Palace in September of 1882 (Jude Philp, personal communication). Redescription is based on the specimen from Kira Kira vill., Makira (= San Cristobal) Island.

References: Cox (1870: 84), as *Diplommatina brazieri*; Pfeiffer (1876: 84), as *D.[iplommatina] Brazieri*; Kobelt & von Möllendorff (1898: 152), checklist, as *Palaina* Subgen. *Palaina* s. str. *brazieri*; Kobelt (1902: 395), as *P.[alaina] (P.[alaina]) brazieri*; Solem (1960: 49); Clench (1965: 5, pl. 2 fig. 4); Gardner (1990: 7).

Measurements: H = 3.5 mm, D = 1.8 mm, HW = 1.8 mm, PD = 1.6 mm.

Description: Shell is large, whitish, dextral, apex is conical. Shell with 6¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture



is rather deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a flat broad impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with very widely-spaced coarse sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 5-6 ribs per 1 mm. The ribs becoming more distant on the ultimate whorl. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. All margins of the peristome are not sinuous. The inner peristome forms a continuous polished callus which is expanding and covering over a half of the ultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: According to the original description this species was originally found on wet places in montane areas. Gardner (1990) signals specimens were sampled from leaf litter. San Cristobal Island was initially covered by primary lowland rainforest. Distribution: Solomon Islands: Makira (= San Cristobal) Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated at least 4000 km² taking into account the area of Makira and adjacent islets. The population size and trend are unknown. The main threat for this species is unknown. Further research is required to clarify status of this species in the wild, assess its distribution, population size, trend and highlight threats.

***Palaina* (s. l.) *bundiana* Wiktor, 1998** (Plate 34 figs 13-15, map 26)

Holotype UWCP: Museum of Nat. Hist., Wrocław Papua- New Guinea, Prov. Madang. Bundi, near mission (SW of Madang) ca 1400 m a.s.l. Leg.A.Wiktor 23.10.1990 No. 2556 [printed] / *Palaina bundiana* n.sp. Wiktor Holotypus! Det. et leg. A.Wiktor No. MP 662 [printed] / *Holotypus!* [printed] / *Palaina bundiana* A.Wiktor [printed]. Paratype 1 adult UWCP: *Museum of Nat. Hist., Wrocław* Papua- New Guinea, Prov. Madang. Bundi, near mission (SW of Madang) ca 1400 m a.s.l. Leg.A.Wiktor 23.10.1990 No. 2556 [printed] / *Palaina bundiana* n.sp. Wiktor Paratypi Det. et leg. A. Wiktor No MP 662 [printed] / *Paratypus!* [printed] / *Palaina bundiana* A.Wiktor [printed].

References: Wiktor (1998: 19).

Measurements: Holotype H = 3.1 mm, D = 1.5 mm, HW = 1.6 mm, PD = 1.05 mm. Paratypic specimen H = 2.8 mm, D = 1.5 mm, HW = 1.4 mm, PD = 0.9 mm.

Description: Shell mid-sized, whitish to pale rose, sinistral, high conical. Shell with 6½ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, it is slightly wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse dense slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 6-8 ribs per 0.5 mm. Spaces between ribs are smooth. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, all margins are not sinuous. The inner peristome forms a continuous polished callus. The basal margin of the outer peristome is somewhat reflexed. No specimens were available to study the internal lamellae. The operculum is primitive - circular, transparent, with few concentric lines.

Ecology: This species is reported from abandoned gardens (= degraded lower montane rainforest) on a steep cliff at 1300-1400 m. Specimens observed in very wet conditions under pieces of decaying wood.

Distribution: Eastern New Guinea: Madang Province.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The current AOO is 8 km², but the maximum AOO is likely much higher. The population size and trend are unknown. *P. bundiana* is generally not abundant species which is known from one locality. Threats are unknown but since *P. bundiana* occurs also in degraded rainforest habitats where wet leaf litter is available. Further research is required on distribution of this species, its population size and threats.

***Palaina* (s. l.) *carbavica* O. Boettger, 1891** (Figs 52, 119-120, plate 34 figs 16-20, maps 7 & 10)

Lectotype SMF: *Palaina carbavica* Bttgr. Gunung Carbau, Hitu, N.Amboina. × D? Ad. Strubell 90. [handwritten] / Senckenberg.Mus. [printed] 105155/01 [handwritten] Frankfurt-M. [printed] *Palaina carbavica* O.Boettger



Lectotypus! Orig. 1891 T.4 F.5 N-Amboina: Gunung Carbau, Hitu A.Strubell 1890 [handwritten] Sammlung O.Boettger [printed].

Paralectotypes SMF: 5 adults: *Palaina carbavica* Bttgr. Gunung Carbau, Hitu, N.Amboina. ^xD? Ad. Strubell 90. [handwritten] / Senckenberg.Mus. [printed] 105156/5 [handwritten] Frankfurt-M. [printed] *Palaina carbavica* O.Boettger Paratypoide! Orig. 1891 T.4 F.5 N-Amboina: Gunung Carbau, Hitu A.Strubell 1890 [handwritten] Sammlung O.Boettger [printed]. 3 adults: *Pal. carbavica* Bttg. xxHitu, Amboina [handwritten, label yellow] / Senckenbg.Mus. [printed] 105156/5 [handwritten] Frankfurt-M. [printed] *Palaina (Cylindrop.) carbavica* O.Bttgr. Paratypen N-Amboina: Gunung Carbau, Hitu A.Strubell 1890 [handwritten] Sammlung O.v.Moellendorff [printed]. 1 adult: *Pal. carbavica* Bttg. Ema auf Leitimor, S. Amboina. xA. Strubell 90. [handwritten] / Senckenbg.Mus. [printed] 105157/1 [handwritten] Frankfurt-M. [printed] *Palaina (Cylindrop.) carbavica* O.Bttgr. Paratypus S-Amboina: Ema auf Leitimor A.Strubell 1890 [handwritten] Sammlung O.Boettger [printed]

Additional material: 1 adult KGC: INDONESIA E, Prov. Maluku tengah, Seram N, distr. Seram Utara, Trans-Seram road between Masohi and Sawai, Horale (former Saka) vill. ~7 km SW, river valley, 02°59'15"S, 129°02'37"E, 07.IV.2009, primary lowland rainforest, leg. K.Greke; 3 adults & 1 subadult KGC, 2 adults & 1 subadult NME: INDONESIA E, Central Moluccas, Lease Islands, Haruku Is., Pulauw vill. 3.3 km S, 03°32'30"S, 128°27'15"E, 150-170 m, 18.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner; 3 adults, 3 subadults KGC, 3 adults & 1 juv. NME: INDONESIA E, Central Moluccas, Lease Islands, northern arm of Ambon Is., Waai 4 km NW, 03°32'56"S, 128°17'17"E, 300 m, 19.VIII.2016, secondary lowland rainforest, leaf litter, leg. L.Wagner.

References: Boettger O. (1891: 286, pl. 4 fig. 5); Kobelt & von Möllendorff (1898: 133), checklist, as *Palaina* Subgen. *Cylindropalaina* Mlldff. *carbavica*; Kobelt (1902: 394); van Benthem Jutting (1953: 287); Zilch (1953: 14, pl. 5 fig. 78), as *Palaina (Cylindropalaina* Moellendorff 1897) *carbavica*; Monk et al. (1997: 395).

Measurements: Selected paralectotypic specimens from Ambon Island: H = 2 mm, D = 1.05 mm, HW = 1 mm, PD = 0.7 mm; H = 1.85 mm, D = 1.2 mm, HW = 1 mm, PD = 0.8 mm; H = 1.8 mm, D = 1.05 mm, HW = 1 mm, PD = 0.8 mm.

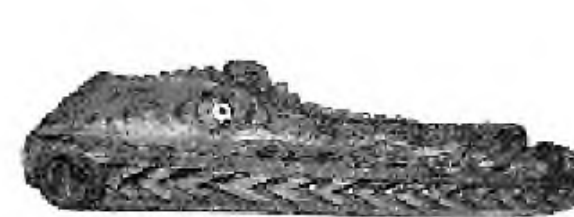
Description: Shell is very small, whitish to pale brown, dextral, cylindrical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically axially striate and with little pits in-between. The suture is rather deeply impressed. The ultimate whorl is slightly narrower than or as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction

is poorly defined by changes in ribbing pattern (axial ribs becoming denser at the constriction) and presence of a shallow short impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with fine, dense, straight ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis. There are 11-12 ribs per 0.5 mm. The ribs becoming more widely-spaced on the last half whorl. Spiral striae are very delicate and dense. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The columellar margin of the outer peristome is slightly sinuous. The columella is smooth and rather broad, provided with a very large triangular median knob which is directed backwards. The operculum is derivative, circular with concentric ridges on the outer surface.

Ecology: This species inhabits primary and secondary lowland rainforests on limestone soils. Specimens occur in leaf litter on the undersides of fallen leaves and pieces of decaying wood, as well as on limestone rocks.

Distribution: Lease Islands (Central Moluccas): Ambon Island, Haruku Island, Seram Island.

Conservation status: Near Threatened, NT. The current EOO is about 2170 km², but the maximum EOO is at least 4000 km² considering the total area of Ambon, Haruku and adjacent part of Seram. The current AOO is about 28 km², but the maximum AOO estimated higher but definitively below the threshold of 500 km². The population size and trend are unknown. However, *P. carbavica* is not uncommon species on Ambon and Haruku. This species is currently known from several localities and inhabits lowland rainforests preferring those on limestone soils. The population is not severely fragmented. Habitat loss is the main threat. Deforestation reasons are forest conversion to gardens, timber use for building construction and for firewood. Expanding settlements require more space and forest is cleared also for new villages. Human population growth is rampant on Lease Islands. On the other hand, interior of Seram is still pristine and mountains of Ambon are not much affected by human activities. There are at least 5 locations. Continuing decline in extent and quality of habitat for this species is documented and projected for two



locations, resulting in the Ambon AOO decline. Here *P. carbavica* can also be found in disturbed forests with partly closed canopy. No decline in AOO is hitherto documented for Haruku and Seram locations. There are no nature conservation areas on Lease islands to protect populations of *P. carbavica*. Further research is required on distribution of this species and population size to be measured. Establishing nature conservation area to protect remaining old-growth forests on Haruku and Ambon is highly recommended.

***Palaina* (s. l.) *chrysostoma* E.A. Smith, 1897** (Figs 50-51, plate 35 figs 1-13, map 14)

Syntype 1 adult BMNH: *Diplom chrysostoma* Smith I. Flores 4000ft. AM.S. 8.67-44. [handwritten] / *chrysostoma*, Smith I. Flores [handwritten].

Additional material: 2 adults KGC: INDONESIA, Nusa Tenggara, Flores Is., Ranamese Lake, 08°37.235'S, 120°33.554'E, 1295 m, 08.III.2011, primary lower montane rainforest, soil sample No 2, leg. A.Riedel; 1 adult KGC & 1 adult NME: INDONESIA, Nusa Tenggara, Flores Is., Ranamese Lake, 08°37.024'S, 120°33'40"E, 1270 m, 08.III.2011, primary lower montane rainforest, soil sample No 3, leg. A.Riedel. 2 adult KGC & 1 adult NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.386'S, 120°31.156'E, 1575 m, 10.III.2011, primary lower montane rainforest, soil sample No 11, leg. A.Riedel; 1 adult KGC: INDONESIA, Nusa Tenggara, Flores Is., Tebedo, 08°29.848'S, 119°59.633'E, 525 m, 14.III.2011, primary lowland rainforest, soil sample No 1, leg. A.Riedel.

References: Smith E.A. (1897a: 626); Kobelt & von Möllendorff (1898: 133), checklist, as *Palaina* Subgen. *Eupalaina* Kob. et. Mildff. *chrysostoma*; Kobelt (1902: 397), as *Palaina* (*Palaina*) *chrysostoma*; Rensch B. (1931: 390).

Measurements: Selected syntype H = 6 mm, D = 3.5 mm, HW = 3.1 mm, PD = 2.7 mm. Selected specimens from Lake Ranamese env.: H = 5.3 mm, D = 3.1 mm, HW = 2.9 mm, PD = 2.4 mm; H = 5.2 mm, D = 3.5 mm, HW = 2.9 mm, PD = 2.6 mm; H = 5.1 mm, D = 3 mm, HW = 3 mm, PD = 2.3 mm.

Description: Shell is very large, yellowish brown, dextral, cylindrical, with conical apex. Shell with $7\frac{1}{3}$ convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short shallow impression and suture is deeply impressed over the constriction. The constriction is centered in apertural view or is shifted and situated on same axis with the columellar side

of the aperture. A strong bulb developed just beyond the constriction, above the columellar side of the aperture. The teleoconch is sculptured with fine dense slightly sinuous ribs. There are rather abrupt changes in the ribbing pattern from very dense on early whorls to widely-spaced on the (pen)ultimate whorl(s). The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 21-24 ribs per 1 mm. The ribs becoming 3-4x more distant on the last half whorl. In specimens from Mt. Ranaka the axial ribs are much more widely-spaced on two last whorls than in type specimens or Lake Ranamese material. In other specimens the axial ribs are strongly reduced and very flat on two last whorls. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular or oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, very broad in lateral view, consists of numerous thin lamellae in lateral view. The palatal margins of both peristomes are inconspicuously sinuous. The inner peristome forms a very broad continuous polished callus. The parietal margin of the peristome has a flat callus. The columella is shiny and broad provided with a more or less distinct knob-like columellaris at the base. The columellaris is visible (in most specimens) in the aperture in a form of a very flat callus. The operculum is derivative, circular, on the outer surface with several low internal concentric ridges and one high outer concentric ridge.

Ecology: This species occurs in leaf litter of primary lowland to mid montane rainforests, it is observed at altitudes 525-1575 m.

Distribution: Lesser Sunda Islands: Flores Island. Conservation status: Near Threatened, NT. The current EOO about 310 km² (inclusive ~60 years old records). The maximum EOO estimated about 5000 km² taking into account total area of Flores and adjacent Lembata, Alor and smaller islets. The current AOO is 12 km². The maximum AOO for this species is definitively below 500 km². No information is available on the population size and trend, but this species seems widespread on Flores. This species avoids arid and deforested lowlands. The population is not severely fragmented, but the fragmentation grade is likely to increase. Habitat loss is the main threat. Drivers for it are conversion of the rainforests to gardens, timber collecting and small-scale logging. These activities result in habitat alteration, fragmentation and decline in AOO. Growing human population of Flores combined



with more frequent and longer dry periods caused by global warming and El Niño weather patterns will likely have continued negative effect on the remaining natural rainforests of Flores. Between 2001 and 2014, Flores, its adjacent islands of Lembata, Adonara, Solor and Rinca lost almost 29000 ha of lowland forest (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Human population is not moving from lowlands to montane areas, but wet mountains are threatened by expanding gardens and logging for construction purposes. Considering aforementioned facts, this trend is likely to cause continuing decline in the AOO. There are 4 locations. Continuing decline is projected based on the present trend of forest loss. Further research is required on distribution of this species and its population size. Monitoring is to be performed for the known subpopulations.

***Palaina* (s. l.) *citrinella* van Benthem Jutting, 1963** (Plate 35 figs 14-16, map 26)

Holotype NMNL: Indonesia, Papua, bij Ajapo aan het Sentanimmeer, bos, 1954.11.06 Exp. L.D. Brongersma c.s. 1954-1955 [printed].

References: van Benthem Jutting (1963: 707).

Measurements: Holotype H = 3.5 mm, D = 1.8 mm, HW = 1.9 mm, PD = 1.2 mm.

Description: Shell is large, white or yellowish with brownish apex, sinistral, cylindrical, with blunt apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, it is slightly narrower than or as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a very shallow impression and a zone of denser placed axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate irregularly dense sinuous ribs. The ribs becoming more widely-spaced on the last half whorl. In fully grown specimens the ribs becoming higher (somewhat lamella-like) near the suture. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 10-11 ribs per 1 mm. Spiral striae are very delicate. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a narrow continuous polished callus. The margins

of the inner peristome are not sinuous. The palatal margin of the outer peristome is slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Species occurs in lowland rainforests on limestone soil.

Distribution: Northern New Guinea: Lake Sentani. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from material sampled over 60 years ago from single locality and has not been found again. The type locality is situated near Jayapura, the administrative capital of Indonesian New Guinea. This region is a subject of deforestation and only small patches of natural rainforest vegetation are remaining here. The population size and trend are unknown. Further research is required to clarify the status of *P. citrinella* in the wild, evaluate its population size and highlight threats.

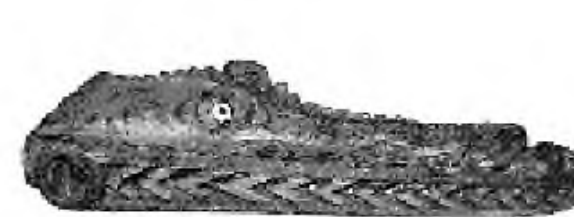
***Palaina* (s. l.) *clappi* Solem, 1960** (Plate 35 figs 20-22, map 11)

Holotype UMMZ: *Palaina clappi* Solem HOLOTYPE FLW18, behind Halavo, Florida Id., R.E. Kuntz! 1944 Solomon Is. UMMZ 181755 ~~20495~~ [original correction] [handwritten] / 181755 Holotype [text red] Diplommatinidae *Palaina clappi* Solem, 1960 Solomon Islands; Central; Florida Islands: Halavo Kuntz, R. E., 1944: Dry; 1 University of Michigan Museum of Zoology Mollusk Division [printed, red border].

Paratype FMNH: 55207 [printed] / 55207 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 1 dry spec. Paratype(s): *Palaina clappi* Solem, 1960 Sta. RK-55207, Solomon Islands, Florida Island, Halavo, FLW 18 22 Oct 1944, R. Kuntz! Ex University of Michigan Museum of Zoology [printed].

References: Solem (1960: 50, 51, pl. 6 fig. 3).

Measurements: Holotype H = 2.3 mm, D = 1.7 mm, PD = 1.2 mm (HW is not measured since the ultimate whorl is completely hidden under expanding margin of the peristome in apertural view). Paratype H = 2.35 mm, D = 1.9 mm, PD = 1.1 mm. Description: Shell is small, white or pale brown, sinistral, conical, with broadly conical apex. Shell with 4¾-5 convex whorls, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed, especially the suture of the ultimate whorl. The ultimate whorl is strongly constricted and widened again at the aperture. The ultimate whorl is narrower than the penultimate whorl in apertural view. The ultimate whorl is strongly shifted upwards. The umbilicus is closed in adult. The constriction is not visible from under the expanded parietal margin of the peristome. The teleoconch is sculptured



with delicate dense slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 8-9 ribs per 0.5 mm. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is oval or subquadrangular and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is simple (the parietal margin is almost straight) with a very broad zone of numerous dense lamellae on the ultimate whorl prior to the peristome. The parietal margin of the peristome is not fully attached to the ultimate whorl. The parietal margin of the inner peristome is strongly expanding and completely overrunning (covering) the ultimate whorl in apertural view. The parietal / columellar junction of the peristome developed in an obtuse angulation. The margins of the peristome are not sinuous. Small flat columellaris is visible deep in the aperture. No specimens were available to study the internal lamellae. The operculum is derivative - in a form of a flying disc, with raised margin, without concentric ridges.

Ecology: Type specimens sampled from leaf litter. Distribution: Solomon Islands: Nggela (= Florida) Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from specimens sampled over 70 years ago from single locality. The population size and trend are unknown. Threats for *P. clappi* are unknown. Further research activities are required on this species.

***Palaina* (s. l.) *commixta* I. Rensch, 1937** (Fig. 54, plate 36 figs 1-17, map 28)

= *Palaina commixta jacquinoti* I. Rensch, 1937

syn. nov. (Plate 36 figs 8-11)

Holotype *P. commixta* MHUB: Malkong [handwritten] / Zoolog. Museum Berlin. [printed] 90949 *Palaina commixta* I. Rensch. Neu-Pommern Weite Bucht Malkong Ig. P. Schneider. [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina commixta* I. Rensch Arch. Naturg. N.F. Bd.6. H. 4. 1937, S. 604-605 Abb. 42. [handwritten] [label red].

Holotype *P. commixta jacquinoti* MHUB: Zoolog. Museum Berlin. [printed] *Palaina commixta jacquinoti* I. Rensch * Neu-Pommern Jacquinotbucht Pormea Ig. P. Schneider 90953. [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina commixta jacquinoti* I. Rensch Arch. Naturg. N.F. Bd.6 S.605, 1937 [handwritten] [label red].

Additional material: 2 adults, 1 subadult & 2 juv. UF: UF 366585 Mollusca, Diplommatinidae 5 specimen(s) *Palaina* sp.10 Papua New Guinea, East New Britain

Province New Britain 12 km N Marmar Village along trail to Pakia Village secondary hill forest 900 meters 5.43187° S 151.45971° E Slapcinsky, J. 25-February-2005 JS-0772 dry FLORIDA MUSEUM OF NATURAL HISTORY / Mollusca 366581; 6 adults, 1 subadult & 6 juv. UF: UF 366580 Mollusca, Diplommatinidae 12 specimen(s) *Palaina* sp. 10 Papua New Guinea, East New Britain Province New Britain Saukale, 13 km NW Marmar Village along trail to Pakia Village primary hill forest 850 meters 5.42551° S 151.45337° E Slapcinsky, J. 28-February-2005 JS-0775 dry FLORIDA MUSEUM OF NATURAL HISTORY / 775 / Mollusca 366580; 1 adult UF: UF 366578 Mollusca, Diplommatinidae 5 specimen(s) *Palaina* sp.10 Papua New Guinea, East New Britain Province New Britain 12 km N Marmar Village along trail to Pakia Village secondary hill forest 450 meters 5.49651° S 151.49027° E Slapcinsky, J. 04-March-2005 JS-0777 dry FLORIDA MUSEUM OF NATURAL HISTORY / JS 777 / *Palaina*; 5 adults UF: UF 366585 Mollusca, Diplommatinidae 5 specimen(s) *Palaina* Papua New Guinea, East New Britain Province New Britain, Renis Peninsula, E of Galowe Village primary coastal forest 1 meters 5.52071° S 151.48331° E Slapcinsky, J. 06-March-2005 JS-0778 drowned in water > 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY / 778; 5 adults & 4 juv. UF, 1 adult KGC: UF 366579 Mollusca, Diplommatinidae 12 specimen(s) *Palaina* Papua New Guinea, East New Britain Province New Britain, Renis Peninsula, E of Galowe Village primary coastal forest 1 meters 5.52071° S 151.48331° E Slapcinsky, J. 06-March-2005 JS-0778 dry FLORIDA MUSEUM OF NATURAL HISTORY / Mollusca 366579.

References *P. commixta*: Rensch I. (1937: 604).

References *P. commixta jacquinoti*: Rensch I. (1937: 605).

Measurements: Holotype *P. commixta* H = 2.7 mm, D = 1.5 mm, HW = 1.5 mm, PD = 1.2 mm. Holotype *P. commixta jacquinoti* H = 2.9 mm, D = 1.55 mm, HW = 1.6 mm, PD = 1.2 mm. Specimens from Galowe vill. env. H = 3.5 mm, D = 2 mm, HW = 1.3 mm, PD = 1.5 mm; H = 3.1 mm, D = 2 mm, HW = 1.8 mm, PD = 1.4 mm; H = 3.2 mm, D = 2 mm, HW = 1.65 mm, PD = 1.5 mm.

Description: Shell is small, white or pale brown, sinistral, conical, with conical apex. Shell with 5¾ convex whorls, the 1¾-2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is defined by a short shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense straight or sinuous ribs. On the teleoconch, the ribs are bending counter-clockwise on the peripheries of whorls. The ribs becoming much coarser and more



widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight to the coiling axis. There are 10-11 ribs per 1 mm. Spiral striae are very delicate, dense. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal side of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. Peristomal margins are not sinuous or the palatal and columellar margins are distinctly sinuous. The columella is smooth and broad, obliquely twisted in its lower fourth, forming a horizontal columellaris. The columellaris is directed outwards but is not visible in the aperture. The operculum is derivative, circular and transparent, strongly impressed on the outer surface, with irregular low ridge along about the half of the periphery of the inner surface, without concentric lines.

Ecology: Primary and secondary lowland rainforests, leaf litter.

Distribution: Bismarck Archipelago: New Britain Island.

Conservation status: Least Concern, LC. The current EOO is about 40 km², but the maximum EOO estimated significantly higher. The current AOO is 12 km². This species is abundant in historical material from Jacquinet Bay env. and is not uncommon in recently collected material. *P. commixta* inhabits both primary and disturbed lowland rainforests and is reported from sea level up to 950 m. New Britain is still forested and pristine, especially in its central part. However forests being converted to gardens, especially along coastline and at lower altitudes. The area of New Britain covered by rainforest is decreasing constantly, between 2001 and 2014 about 166000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). But the population of *P. commixta* seems stable during over 90 years and threats cannot be identified.

***Palaina* (s. l.) *consobrina* van Benthem Jutting, 1963** (Plate 35 figs 17-19, maps 23)

Holotype NMBL: Humboldt Bay.

Paratype NMBL: Kali Berap, near Berap, NW of Genjiem, Numbou, 4.XI.1954, Exp. Bongersma [not studied].

References: Bavay (1908: 290), as *Diplommatina papuana*; van Benthem Jutting (1963: 705, pl. 29 fig. 26).

Measurements: Holotype H = 3.9 mm, D = 2.7 mm, HW = 2.1 mm, PD = 2 mm. Paratype (according to the original description) H = 4.8 mm, D = 2.7 mm, PD = 2.5 mm.

Description: Shell is large to very large, white or yellowish brown, sinistral, obese, with broadly conical apex. Shell with 6 convex whorls, the 1.5-2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, ascending, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a broad flat impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense strongly sinuous ribs. The ribs are less dense on the ultimate whorl than on preceding ones. The ribs becoming higher, lamella-like near the suture and rise over it. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are strongly oblique to the coiling axis. There are about 10 ribs per 1 mm. Spiral striae are strong but visible on the ultimate whorl only. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. A broad zone of numerous dense lamellae present on the ultimate whorl prior to the peristome. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a continuous polished callus which expands upwards and covering most of the ultimate whorl in apertural view. Peristomal margins are not sinuous, just the palatal margin is somewhat sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

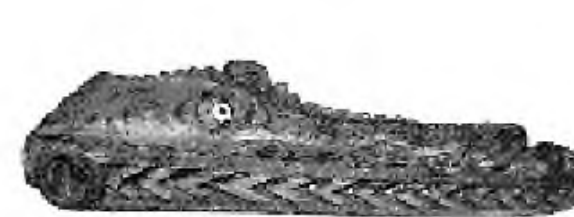
Ecology: Unknown.

Distribution: Northern New Guinea: near Jayapura and Lake Sentani.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from two specimens sampled over 70 years ago from two localities. No information is available on the population size and trend. Further basic research is required on this species.

***Palaina* (s. l.) *cupulifera* van Benthem Jutting, 1963** (Plate 35 figs 23-25, map 26)

Holotype NMNL: Schouten Islands, E of Biak, Bosnik, on coral rock Near sago swamp, Toxopeus, L.J., 1938.06.16.



References: van Benthem Jutting (1963: 704, pl. 29 fig. 25).

Measurements: Holotype H = 4.5 mm, D = 3.1 mm, HW = 2.5 mm, PD = 2.3 mm.

Description: Shell is very large, white, sinistral, very obese, with flattened apex. Shell with 6 rather flat whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is ascending, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. Teleoconch sculpture on first two whorls consists of very conspicuous axial ribs. Those ribs are very widely-spaced and curved backwards in a form of large, cup-shaped pits. The rest of teleoconch is covered with widely-spaced sinuous ribs. There are abrupt changes in the ribbing pattern from strongly curved on the early whorls to dense on the younger ones. The ribs are not synchronized with those of the previous whorls and are strongly oblique to the coiling axis. There are about 7 ribs per 1 mm. Spiral striae are delicate. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is double, with several flat circular lamellae between the inner and outer peristome. The ultimate whorl provided with numerous dense lamellae prior to the peristome. The peristome expands and overruns (covering) the ultimate whorl in apertural view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a continuous polished callus, which expands upwards and covers most of the ultimate whorl in apertural view. Peristomal margins are not sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Specimens were sampled in a swampy area on limestone soil.

Distribution: Cenderawasih Bay: Biak Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 7800 km² taking into account the area of Biak, Supiori, Numfoor and adjacent islets. This species is known from two specimens sampled over 80 years ago from one locality. Biak is widely known by high proportion of endemic molluscs (e.g. van Benthem Jutting 1963). No information is available on the population size and trend for *P. cupulifera*. Threats are not known. Further basic research is required on this species.

***Palaina* (s. l.) *dianctoides* sp. nov.** (Plate 36 figs 18-24, map 22)

<http://zoobank.org/31EECAA7-BBB1-4FE5-8FAA-162D7D25F6D0>

Holotype NME: INDONESIA E, West Papua, Onin Peninsula, Fak-Fak 40-42 km NE, between Kokas & Goras vill., 2°43'19"S, 132°37'57"E, 0-10 m, 27.IX.2010, primary lowland rainforest on limestone, limestone cliff, leg. K.Greke.

Derivatio nominis: This name should point on conchological similarity with representatives of the diplommatinid genus *Diancta* Martens, 1864.

Measurements: Holotype H = 3.95 mm, D = 2.4 mm, HW = 1.9 mm, PD = 1.85 mm.

Description: Shell is large, orange brown, dextral, high cylindrical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The penultimate whorl is bulbous. The ultimate whorl is constricted, slightly ascending and distinctly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a deep broad impression supplemented with a zone of denser placed axial ribs. There is a strong bulb just beyond the constriction above the columellar side of the aperture. The constriction is situated close to the columellar axis of the aperture. The teleoconch is sculptured with moderately coarse, dense, straight or slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 15-16 ribs per 1 mm. The ribs becoming twice more widely spaced on the last half whorl. Spiral striae are very delicate, dense. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, very thick in lateral view and consists of numerous dense lamellae. Peristomal margins are not sinuous. The inner peristome forms a continuous polished callus, expands strongly and covers over a half of the ultimate whorl in apertural view. The outer peristome is broadly discontinued parietally. Because only one specimen was available for study, I did not damage the shell to study the internal lamellae. The operculum is derivative - circular, flat, with several low concentric ridges on the outer surface.

Differential diagnosis: This species is unique within *Palaina* due to the combination of the follow-



ing characters: shell is large, the penultimate whorl is bulbous, wider than the ultimate whorl, very strong postconstriction bulb is presents, the inner peristome expands into a very broad continuous callus, the parietal margin of the inner peristome covers most of the ultimate whorl in apertural view, the operculum is without concentric ridges or raised margin.

Ecology: The single specimen was found on coastal limestone cliff in primary lowland rainforest about 20 m from the sea shore.

Distribution: New Guinea: Onin Peninsula.

Conservation status: Data Deficient, DD. Not enough data available to calculate current and maximum EOO. The current AOO is 4 km², the maximum AOO is likely much higher. No information is available on the population size and trend. Threats are unknown for this species. Further basic research is required.

***Palaina* (s. l.) *diepenheimi* (Preston, 1913) comb. nov.** (Plate 37 figs 1-7, map 6)

Lectotype BMNH [herewith designated]: *Diancta diepenheimi* Pre[ston] Beilan – Beilan Isl. Moluccas (Type in tube). 1914.1.4.435-1944.5.8.1-3 [handwritten] / Type. [printed] / *diepenheimi* Preston. Dutch. E. Indies. [handwritten].

Paralectotypes 3 adults BMNH [herewith designated]: same labels as lectotype.

Additional material: 1 adult MHUB: 63794 [handwritten] / Zoolog. Museum Berlin [printed, text underlined] *Diancta diepenheimi* Prest. 1913 lsd. of. Beilan-Beilan Moluccen [sic!] Preston 63794 [handwritten]; 1 adult ZSM: Zoolg. Staatssammlg. München, Abt. Wirbellose Tiere [underlined] *Diancta tiessenhauseni* Prest. Ins.Beilan-Beilan Typ. [printed] / 6.4. [handwritten].

Lectotype designation: Lectotype is selected from four syntypes, all with same labels.

Notes: This species is lacking typical characters of *Diancta* Martens, 1864 (e.g. bulbous penultimate whorl, presence of longitudinal parietalis). Consequently I decided to move it to *Palaina* (s. str). The lectotype is selected from a series of 4 syntypes all with the same labels.

References: Preston (1913: 438), as *Diancta diepenheimi*.

Measurements: Lectotype H = 3.2 mm, D = 1.7 mm, HW = 1.4 mm, PD = 1 mm. Selected paralectotype specimens: H = 3.1 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1.1 mm; H = 2.8 mm, D = 1.7 mm, HW = 1.4 mm, PD = 1 mm.

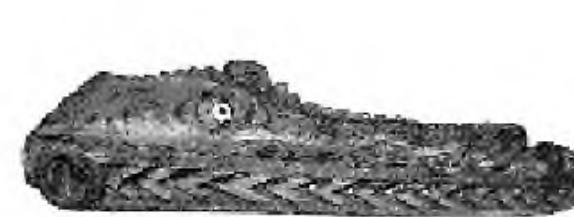
Description: Shell is small to moderately large, whitish to pale brown with darker protoconch, dextral, high cylindrical with convex apex. Shell with

5½-6½ moderately convex whorls, the 1½ embryonic whorl is smooth. The suture is rather deeply impressed. The ultimate whorl is constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short distinct impression. The constriction situated on same axis with the palatal side of the aperture (exception is one paralectotype in which the constriction is centered on the apertural side). The teleoconch is sculptured with coarse widely-spaced, slightly sinuous axial ribs on the early and the central whorls. The ribs becoming more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 8 ribs per 1 mm, but 9-10 ribs over the aperture. Extremely delicate and dense spiral striae are present on teleoconch whorls (one paralectotype has very distinct striation). The penultimate whorl has the upper and lower margins parallel or almost parallel in apertural view. The aperture is tilted about 5-10° to the coiling axis and is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The parietal margin of the peristome is completely or not completely attached to the ultimate whorl. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. The palatal margins of both peristomes are sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Belangbelang Island is covered by primary lowland rainforest on limestone soil.

Distribution: Southernmost North Moluccas: Belangbelang Island of Obi Islands group. Almost certainly this species should be found on other islands of Obi group, particularly on limestone Obilatu Island.

Conservation status: Data Deficient, DD. *Palaina diepenheimi* is known from type series collected over 100 years ago from single locality. No enough data available to calculate current EOO and AOO. The area of Belangbelang Island is 7 km². The total area of all Obi Islands is about 5100 km². It is very unlikely *P. diepenheimi* occurs all over Obi Islands (especially not on distant Gomumu and Tobalai) and only small fractions of Obi rainforests are located on limestone soils. Consequently, the maximum EOO for this species is certainly below 5000 km². The main threat for this species is unknown. Belangbelang Island is uninhabited, but all neighbouring islands (small Bisa, Obilatu, Tapat and large



Obira) are. The area of Obi Islands covered by rainforest is decreasing constantly, between 2001 and 2014 about 11000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Additional research on Obira Island carried out by the University of Florida (2008), as well as on Bisa and Obira islands by the Entomological Society of Latvia (2011, 2013) gave no result for this species. The population of *P. diepenheimi* is likely small or restricted to Belangbelang and, possibly, Obilatu and Tapat islands. Additional research is required on Belangbelang to clarify population size. Further efforts are required to discover populations of *P. diepenheimi* on Obilatu and Tapat, as well as on Obira.

Remark: A specimen labelled as “*Diancta tiessenhauseni*” in ZSM is conspecific with *Palaina diepenheimi*, is coming from the locus typicus of it and was certainly collected together with the syntypes.

***Palaina* (s. l.) *doberai* sp. nov.** (Fig. 53, plate 36 figs 25-27, map 24)

<http://zoobank.org/5B05B3A9-7546-4A43-9C4D-51765AB399D9>

Holotype NME: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. ~15,5-14 km N, 1°08'04"S, 132°10'59"E to 1°09'29S, 132°11'30"E, ~275-250 m, 02.IX.2015, primary lowland rainforest on limestone, leaf litter, leg. D.Telnov.

Paratypes 4 adults KGC: same label as holotype.

Derivatio nominis: Toponymic. Named after Doberai or the Bird's Head Peninsula of New Guinea where this species occurs. Noun in apposition, invariable.

Measurements: Holotype H = 2.9 mm, D = 1.5 mm, HW = 1.6 mm, PD = 1.3 mm. Selected paratype specimens: H = 2.8 mm, D = 1.55 mm, HW = 1.6 mm, PD = 1.25 mm; H = 2.75 mm, D = 1.5 mm, HW = 1.4 mm, PD = 1.2 mm; H = 2.7 mm, D = 1.5 mm, HW = 1.65 mm, PD = 1.3 mm.

Description: Shell is small, whitish (body yellow), sinistral and rather broadly conical with convex apex. Shell with 6 convex whorls, the 1¼ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is strongly constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by presence of a shallow impression and a zone of denser placed axial ribs. The constriction is more or less centered in apertural view or is situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate rather dense

straight axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 6-7 ribs per 0.5 mm. Spiral striae are lacking. The aperture is tilted about 10-15° to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. The peristome is broad and consists of numerous dense lamellae in lateral view. The inner peristome forms a continuous polished callus. The palatal margins of the inner (stronger) and the outer (less strong) peristomes are sinuous. The columellar margins of both peristomes are sinuous. The columella is smooth and bulbous, provided with a large median knob which is directed backwards. The operculum is primitive - without ridges and impressed on the outer surface.

Differential diagnosis: This species is peculiar among all congeners due to the combination of the following characters: yellow body, large aperture, two last whorls almost equally broad in apertural view, the columella is provided with a large backwards-directed median knob, axial ribs are straight. Ecology: Specimens were collected from leaf litter in primary lowland rainforest on limestone.

Distribution: New Guinea: lowlands of Doberai Peninsula.

Conservation status: Near Threatened, NT. Not enough data available to calculate current EOO. The maximum EOO for this species estimated 8-10000 km² taking into account its estimated distribution (based on limestone soils map for this region). The current AOO is 4 km², but the maximum AOO is significantly larger. The population size and trend are unknown, but this species was found on only one site in the large area. Habitat loss and alteration caused by logging, mining, and conversion of forests into gardens and plantations, as well as the expansion of human settlements in lowland areas considered the main threats. The forested part of the maximum EOO is decreasing constantly, between 2001 and 2014 over 10000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Continuing decline in extent and quality of habitat is observed and projected for *P. doberai* sp. nov. Taking into account constantly growing human population of Doberai Peninsula, this trend is likely to continue. Further research is required in order to clarify population size and trend for this species.



***Palaina* (s. l.) *dohertyi* E.A. Smith, 1897** (Fig. 55, plate 37 figs 8-21, map 24)

Lectotype BMNH [herewith designated]: *Palaina* [original correction] *dohertyi*, *Smith*? Types [correction on the label] Kapaur N. Guinea novoguineensis Smith TYPES 1897.4.30.53-6 [handwritten] / *dohertyi*, [correction on the label] *Smith* Kapaur New Guinea [handwritten] / Type. [printed].

Paralectotypes 3 adults BMNH [herewith designated]: same labels as lectotype.

Additional material: 1 adult FMNH: 72772 [printed] / 72772 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 1 dry spec. Possible Syntype(s): *Palaina dohertyi* E.A. Smith, 1897 Sta. FMNH72772, Indonesia, West Papua, New Guinea, Kapaur ex F.F. Laidlaw ex H. Fulton (Acc.# 11666) [printed]; 8 adults KGC, 5 adults & 1 subadult NME: INDONESIA E, West PAPUA, Onin Peninsula, Fak-Fak 10 km E, 2°56'32"S, 132°23'01"E, Sakarteman vill. 1-4 km W, River Sakarteman valley, 350-450 m, 26.IX.2010, primary lowland rainforest on limestone, leg. K.Greke.

Lectotype designation: Lectotype is selected from a series of 4 syntypes, all with the same labels.

Note: Originally labelled '*Palaina dohertyi*'. 29.1.1962 note from Dr. Whitehead reads 'These shells are not *dohertyi* but probably *novoguineensis* described at the same time'. 24.9.1962 note from van Benthem Jutting reads 'These shells are certainly *Palaina dohertyi* and not *novoguineensis*. The latter is dextral and more obese. However the notations of the figures in the paper were reversed, *dohertyi* being pl. 9, fig. 32-33 and *novoguineensis* on pl. 9, fig. 30-31'. I herewith re-confirm that according to the original description, four shells of '1897.7.30.53-56' belong to *Palaina dohertyi* but the figures in the original descriptions of both *P. dohertyi* and *P. novoguineensis* were reversed

References: Smith E.A. (1897b: 418, pl. 9 figs 32-33 not 30-31); Kobelt & von Möllendorff (1898: 132), checklist, as *Palaina* Subgen. *Eupalaina* Kob. et. Müllff. *dohertyi*; Kobelt (1902: 398), as *Palaina* (*Palaina*) *dohertyi*; van Benthem Jutting (1963: 703).

Measurements: Lectotype H = 2.9 mm, D = 1.7 mm, HW = 1.4 mm, PD = 1.4 mm. Selected specimens from River Sakarteman valley: H = 2.95 mm, D = 1.9 mm, PD = 1.1 mm; H = 2.95 mm, D = 1.8 mm, PD = 1 mm; H = 2.8 mm, D = 1.6 mm, PD = 1.3 mm; H = 2.9 mm, D = 1.6 mm, PD = 1.3 mm.

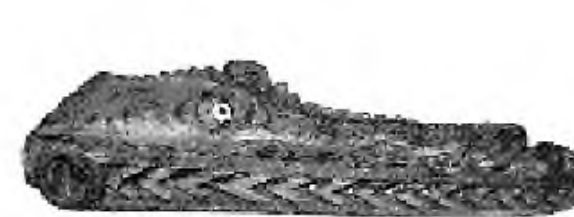
Description: Shell is small, white with yellow 2-4 first whorls, sinistral, narrow and high conical. Shell with 8 convex whorls, the 1¾ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, nar-

rower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a short shallow impression and changes in ribbing pattern (The ribs becoming less conspicuous and lower in the constriction). The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced strong and high humped and sinuous lamella-like axial ribs. The ribs becoming very widely-spaced on the last half whorl. There are abrupt changes in the ribbing pattern at the constriction area (see above). The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 4 ribs per 0.5 mm. Spiral striae are very delicate and dense. The aperture is tilted about 15° to the coiling axis and is circular and has entire apertural rim. In apertural view the position of the aperture is more or less central below the coiling axis or slightly shifted left. The peristome is double, very broad and expanding in lateral view but less strong in certain specimens. Laterally the peristome consists of numerous dense lamellae. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. Both the inner and outer peristomes are not sinuous or slightly sinuous on the palatal margins. The columella is shiny, provided with a flat and long median knob which is directed backwards. The operculum is derivative, moderately high, consists of several layers of concentric ridges and with a broad, spatula-like median "handler" on the inner surface.

Ecology: This species found in primary lowland rainforests on limestone in leaf litter on the undersides of fallen leaves. Reported from altitudes up to 450 m.

Distribution: New Guinea: Onin Peninsula. Record from Aru Islands (Vermeulen 1996c) is based on misidentified specimen of *Palaina vermeuleni* sp. nov. (see description of this species below).

Conservation status: Data Deficient, DD. This species is known from type series sampled over 100 years ago from single locality and from a small recently sampled material. Not enough data available to calculate current EOO. The current AOO is 4 km² but the maximum AOO is likely much higher. The population size and trend are unknown. Onin Peninsula is still very pristine and only coastal areas are affected by development. Additional research is required on distribution, population size and trend and threats to be highlighted.



***Palaina* (s. l.) *erythropeplos* van Benthem Jutting, 1958** (Plate 36 figs 28-30, map 16)

Holotype NMNL: Indonesia, Papua, Misool, Fakal, 0-75 m Lieftinck, M.A. 1948.10.07 [printed].

References: van Benthem Jutting (1958a: 295, 314); van Benthem Jutting (1963: 703).

Measurements: Holotype H = 3.7 mm, D = 2.5 mm, HW = 2.4 mm, PD = 1.3 mm. Selected paratype specimens (according to the original description): H = 4 mm, D = 2.5 mm, PD = 1.3 mm; H = 3.8 mm, D = 2.6 mm, PD = 1.4 mm; H = 3.6 mm, D = 2.4 mm, PD = 1.1 mm.

Description: Shell is large, thin, pink or yellowish, sinistral, cylindrical, with flattened apex. Shell with $5\frac{1}{4}$ - $5\frac{1}{2}$ strongly convex whorls, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is wider than the penultimate whorl in apertural view. The protoconch is placed oblique on the rest of the shell. The umbilicus is narrowly open in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse dense straight ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls. The ribs range from straight to slightly oblique to the coiling axis, except the ultimate whorl which has oblique ribs. There are 9 ribs per 1 mm. Spiral striae are very delicate. The aperture is not or slightly tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, thick and consists of several strong lamellae in lateral view. Peristomal margins are not sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Misool Island is covered by lowland rainforests on limestone soils at locus typicus of this species.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated below 2000 km² taking into account the area of Misool Island and available habitat. The maximum AOO estimated below 500 km². The population size and trend are unknown, this species was not found since 1948. *Palaina erythropeplos* was not uncommon species in northern part of Misool according to its original description. This species was reported from three localities in rainforests on limestone soils. Threats for this species are unknown. Misool Island is still

very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing especially because of establishing new administrative division on Misool (in order to attract funding). Hitherto no large scale deforestation recorded on Misool, but some areas (for example near Lilinta vill. in the SE) suffered from illegal logging over a decade ago. Further basic research is required.

***Palaina* (s. l.) *extremita* sp. nov.** (Fig. 56, plate 37 figs 22-28, map 26)

<http://zoobank.org/6508CE47-6803-4DE0-89A9-33D64D7CCB61>

Holotype UF (No 508073): UF 306120 Diplommatinidae 35 specimen(s) *Palaina* sp. 1 Papua New Guinea, Milne Bay Province waterfall on Upalai Creek, 3 km WNW of Watunoa rainforest 60 meters 10°19.645' S 150°34.608' E Slapcinsky, J. D. 27-February-2003 JS-0615 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / *Palaina* sp 1 [handwritten] / 615 [handwritten] / 306120 [printed].

Paratypes 36 specimens: 23 adults, 1 subadult & 1 juv. UF, 4 adults KGC: same labels as holotype; 4 adults UF: UF 299815 Diplommatinidae 4 specimen(s) *Palaina* sp. 1 Papua New Guinea, Milne Bay Province waterfall on Upalai Creek, 3 km WNW of Watunoa rainforest, in leaf litter and under logs 60 meters 10°19.645' S 150°34.608' E Slapcinsky, J. D. 04-April-2002 JS-0497a dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 497 [handwritten] / 299815 [printed]; 3 adults UF: UF 299817 Diplommatinidae 3 specimen(s) *Palaina* sp. 1 Papua New Guinea, Milne Bay Province Watiho Mountain, W of Naura rainforest, in leaf litter and on ground 345 meters 10°17.121' S 150°10.933' E Slapcinsky, J. D. 06-May-2002 JS-0517 drowned in water > 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 517 [handwritten].

Derivatio nominis: This species is named from Latin “extrēmum” [last, end, final], because it inhabits easternmost part of the Papuan Peninsula of New Guinea.

Measurements: Holotype H = 3.2 mm, D = 1.65 mm, HW = 1.7 mm, PD = 1.4 mm. Selected paratype specimens: H = 3.6 mm, D = 1.8 mm, HW = 1.75 mm, PD = 1.5 mm; H = 3.5 mm, D = 1.7 mm, HW = 1.75 mm, PD = 1.5 mm; H = 3.35 mm, D = 1.8 mm, HW = 1.65 mm, PD = 1.4 mm; H = 3.3 mm, D = 1.6 mm, HW = 1.6 mm, PD = 1.4 mm.

Description: Shell is large, white to pale yellow, sinistral, narrow and high conical with convex apex. Shell with 6 convex whorls, the $1\frac{1}{2}$ embryonic whorl is smooth or finely pitted. The suture is deeply impressed. The ultimate whorl is as wide as or slightly wider than the penultimate whorl in apertural view.



The constriction is poorly defined by a short and shallow impression and a short zone of denser placed axial ribs. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with rather coarse widely-spaced (or very widely-spaced on early whorls and on last half whorl) straight axial ribs. The ribs becoming denser on the penultimate whorl but not abruptly. The ribs are not synchronized with those of the previous whorls. The ribs range from straight to slightly oblique to the coiling axis. There are about 12-13 ribs per 1 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular, apertural rim is entire or discontinued parietally (Plate 37 fig. 28). The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double (this character is not conspicuous) with a very broad zone of numerous dense lamellae on the ultimate whorl prior to the peristome. The inner peristome forms a broad continuous or discontinued (Plate 37 fig. 28) polished callus. Peristomal margins are not sinuous. The columella is smooth, glass-like and semitransparent, provided with a very large median knob which is directed backwards. The operculum is primitive - circular, medially transparent, with somewhat thickened periphery and thin median part.

Ecology: Specimens were sampled from leaf litter and under decaying wood in lowland rainforest on limestone. Reported from 60 to 345 m altitudes.

Distribution: East of the Papuan Peninsula: Milne Province.

Conservation status: Near Threatened, NT. Not enough data available to calculate current EOO. The maximum EOO estimated below 10000 km² taking into account geographical peculiarities of eastern New Guinea and available habitat. The current AOO is 8 km². The maximum AOO is estimated below the threshold of 500 km². The population size and trend are unknown, but this species is not uncommon. Habitat loss and alteration considered the main threats as a result of settlements' expansion and gardening, but the real affect on the population is unknown. It is very unlikely there will be strong decline on the EOO or AOO of this species within next 10 years. Further basic research is required.

***Palaina* (s. l.) *flavocylindrica* sp. nov.** (Figs 57 & 121, plate 37 figs 29-37, map 22)

<http://zoobank.org/578CE064-1E36-4790-9B07-0C89CD41A212>

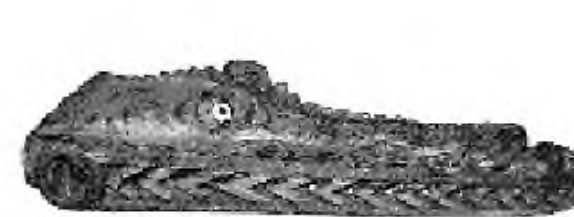
Holotype NME: INDONESIA E, West Papua, S Bird's Neck, Kaimana 2-4 km NE, 3°39'26"S, 133°46'21"E, 150-200 m, 19-20.IX.2010, primary lowland rainforest on limestone, leg. K.Greke.

Paratypes 12 adults KGC & 10 adults NME: same label as holotype; 26 adults KGC, 10 adults NME & 1 LKCNHM: INDONESIA E, West Papua, S Bird's Neck, Kaimana 47 km E, Triton bay, Kamaka (former Warika) vill. env., Lake Kamakawalar and surroundings, 3°46'22"S, 134°12'02"E, 60-310 m, 08.IX.2010, primary lowland rainforest, leg. K.Greke [one adult is badly broken].

Derivatio nominis: This species is named from the combination of the Latin "flavus" [yellow] and "cylindrus" [cylinder], because of cylindrical yellowish coloured shell.

Measurements: Holotype H = 1.55 mm, D = 0.8 mm, HW = 0.8 mm, PD = 0.6 mm. Selected paratype specimens from Kaimana: H = 1.5 mm, D = 0.8 mm, HW = 0.8 mm, PD = 0.6 mm; H = 1.4 mm, D = 0.75 mm, HW = 0.8 mm, PD = 0.6 mm. Selected paratype specimens from Warika vill. env.: H = 1.7 mm, D = 0.8 mm, HW = 0.8 mm, PD = 0.65 mm; H = 1.6 mm, D = 0.8 mm, HW = 0.85 mm, PD = 0.65 mm.

Description: Shell is very small, yellowish with yellow body, sinistral, cylindrical with flattened apex. Shell with 5 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The protoconch is placed somewhat obliquely to the rest of the shell. The ultimate whorl is strongly constricted, as wide as the penultimate whorl in apertural view but distinctly narrower than it in basal view. The umbilicus is closed in adult. The constriction is poorly defined on shell wall, the suture is somewhat impressed above the constriction and axial ribs becoming stronger sinuous here. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate dense straight ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique with regard to the coiling axis. There are about 16-18 ribs per 0.5 mm. The ribs becoming coarse and 2-3x more distant on the last half whorl. Spiral striae not visible at 80x magnification but are very delicate and dense at 300x (there are 9-10 rows of spiral striae per 30 µm measured above the aperture). The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is distinctly double, thick and consists of several dense



lamellae in lateral view. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columellar margin of the outer peristome is slightly sinuous. In specimens from Warika vill. the palatal margins of both peristomes are slightly sinuous. The columella is shiny. The operculum is derivative - in a form of a flying disc, with slightly raised margin and without concentric ridges.

Differential diagnosis: This regularly cylindrical species with flattened apex is peculiar due to the lacking of spiral striae which is only visible (very delicate and dense) at 300x magnification and the peristome provided with several lamellae between the inner and outer peristomes (in lateral view).

Ecology: This species occurs in primary lowland rainforests on limestone soils at altitude 150-200 m. Specimens observed in wet leaf litter, under decaying wood and on limestone outcrops.

Distribution: New Guinea: southern part of Bird's Neck Isthmus.

Conservation status: Least Concern, LC. Not enough data available to calculate current EOO. The maximum EOO for this species estimated 19000 km² taking into account the area of Bird's Neck Isthmus of New Guinea and available habitat. The current AOO is 8 km², the maximum AOO estimated between 500-2000 km² considering available habitat, soil types and biogeographical peculiarities of Bird's Neck. The population size and trend are unknown, but this species is very abundant in suitable habitat. Habitat loss and alteration are the main threats. There are two locations. Coastal areas of southern Bird's Neck are being converted into gardens, settlements and gardens are expanding but steep anticlines are still covered by primary forest. One locality is near Kaimana city and can be affected by small-scale logging activities and limestone extraction. The forested part of the maximum EOO is quite stable. I can't project significant decline in EOO or AOO for this species in next 10 years. Additional research is required on distribution, population size and trend for this species. A nature conservation area should be established in order to protect Bird's Neck's fauna.

***Palaina* (s. l.) *floridensis* Solem, 1960** (Plate 38 figs 10-12, map 11)

Holotype UMMZ: *Palaina floridensis* Solem FLW 18, behind Halvao, Florida Id., R.E. Kuntz! 1944 Solomon Is. HOLOTYPE UMMZ 181756 [handwritten] / 181756 Holotype [text red] *Diplommatinidae Palaina floridensis* Solem, 1960 Solomon Islands; Central; Florida Islands: Halavo Kuntz, R. E., 1944: Dry; 1 University of Michigan

Museum of Zoology Mollusk Division [printed, red border].

Paratypes 4 adults FMNH: 55208 [printed] / 55208 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 4 dry spec. Paratype(s): *Palaina floridensis* Solem, 1960 Sta. RK-55208, Solomon Islands, Florida Island, Halavo, FLW 18 22 Oct 1944, R. Kutz! Ex University of Michigan Museum of Zoology [printed].

References: Solem (1960: 50, pl. 6 fig. 2).

Measurements: Holotype H = 2.2 mm, D = 1.3 mm, HW = 1.1 mm, PD = 1 mm.

Description: Shell is small, yellowish to pale brown, sinistral, broadly conical with flattened apex. Shell with 5¼-5¾ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The penultimate whorl is somewhat bulbous. The ultimate whorl slightly constricted, ascending, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not or slightly defined by a shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense straight ribs. The ribs becoming coarser and higher but not more distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 15 ribs per 1 mm. Spiral striae are delicate and widely-spaced. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple. The ultimate whorl with a broad zone of numerous dense lamellae prior to the peristome. The peristome forms a very broad continuous polished callus which expands and covers more than half of the ultimate whorl. The parietal margin of the peristome is not fully attached to the ultimate whorl. The margins of the peristome are not sinuous. No specimens were available to study the internal lamellae. According to the original description, an inconspicuous columellar callus should be present but was not indicated in studied specimens. The operculum is derivative - in a form of a flying disc, with raised margin, without concentric ridges.

Ecology: Specimens found in rainforest leaf litter. Distribution: Solomon Islands: Nggela (= Florida) Island.

Conservation status: Data Deficient, DD. This species is known from the type series sampled over 70 years ago from single locality. This species has not been collected again. Not enough data available



to calculate current EOO and AOO. The population size and trend are unknown. Additional research is required in order to uncover species' status in the wild, clarify its distribution, population size, trend, as well as highlight threats.

***Palaina* (s. l.) *gardneri* Dell, 1955** (Plate 38 figs 1-9, maps 11 & 19)

= *Palaina delli* Clench, 1965 **syn. nov.** (Plate 38 figs 4-7)

Holotype MONZ: Mono Island, ridge above Seveke River.

Holotype *P. delli* MCZ: Holotype *Palaina delli* Clench ½ mile above the 7th Day Adventist Mission Station - W. Side of Lunga River, Guadalcanal, Solomon Ids 258017 [handwritten] / Holo [handwritten] Type. [printed, label red, glued on the right upper corner of the next label] / Mus.Comp.Zool., Cambridge, Mass. No. [printed] 258017 *Palaina delli* Clench ½ mi. above the 7th Day Adventist Mission Station, W. Side of Lunga River, Guadalcanal, Solomon Ids. Rec: James R. Hood, 1949! " W. Clench 1/65 Acc 579 [handwritten].

Paratypes *P. delli* 5 adults MCZ: same label as holotype.

New synonymy: It is obviously Clench (1965) overlooked description of *Palaina gardneri* published ten years earlier by Dell (1955), because Clench compared his *P. delli* with non-similar *P. brazieri* (Cox, 1870) instead of conchologically identical *P. gardneri*.

References: Dell (1955: 423, 424); Clench (1965: 6, pl. 2 fig. 5), description of *P. delli*.

Measurements: Holotype *Palaina delli*: H = 4.3 mm, D = 2.5 mm, HW = 2 mm, PD = 1.7 mm. Paratype *Palaina delli*: H = 5.2 mm, D = 2.8 mm, HW = 2.4 mm, PD = 2.1 mm. Holotype *Palaina gardneri*: H = 4.6 mm.

Description: Shell is large, brown to pale brown, dextral, narrowly conical with flattened apex. Shell with 6½ rather flattened whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl ascending, it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short zone of denser and stronger sinuous axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate irregularly dense, slightly sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 9-11 ribs per 1 mm. The ribs becoming very widely-spaced on the last half whorl. Spiral striae are lacking. The aperture is

not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The peristome is double, thick and consists of numerous dense lamellae in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The palatal margins of both peristomes are sinuous in certain specimens. The inner peristome forms a broad continuous polished callus. No specimens were available to study the internal lamellae. The operculum is derivative, with concentric ridges on the outer surface.

Ecology: This species inhabits rainforest leaf litter.

Distribution: Solomon Islands: Mono Island, Guadalcanal Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated about 35000 km² taking into account its potential distribution area on the Solomon Islands and available habitat. This species is known from the type series sampled about 50-70 years ago from two distant localities and has not been collected again. The population size and trend are unknown for *P. gardneri*. Threats for this species are unknown. Further research is required to uncover species' status in the wild, calculate its population size, trend and highlight threats.

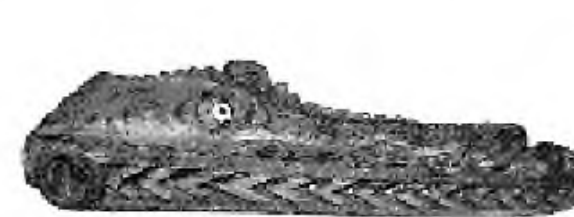
***Palaina* (s. l.) *glabella* van Benthem Jutting, 1963**
(Plate 37 figs 38-40, map 26)

Holotype NMNL: Papua, Biak, humus, Hollander A. dec.1952.

References: van Benthem Jutting (1963: 709, pl. 30 fig. 31).

Measurements: Holotype H = 3.8 mm, D = 1.7 mm, HW = 2.4 mm, PD = 1.6 mm.

Description: Shell is small, creamy, sinistral, obese with flattened apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, slightly wider than the penultimate whorl in apertural view. The umbilicus is closed of very narrowly open in adult. The constriction is defined by a short zone of denser placed axial ribs and suture impressed above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced straight ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 6 ribs per 1 mm. The ribs becoming more



widely-spaced on the last half whorl. Spiral striae are very delicate and dense on all the teleoconch whorls. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, the outer peristome is discontinued parietally. The parietal margin of the peristome is attached to the ultimate whorl. The palatal margin of the outer peristome is sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Specimens found in soil.

Distribution: Cenderawasih Bay: Biak Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 7800 km² taking into account the area of Biak, Supiori, Numfoor and adjacent islets. The maximum AOO estimated below the threshold of 500 km². This species is known from a series of specimens sampled about 70 years ago from three close-situated localities. This species has not been collected again. Biak is widely known by high proportion of endemic molluscs (e.g. van Benthem Jutting 1963). The population size and trend are unknown. Threats for this species are unknown. Habitat loss and alteration are significant threats but cannot be validated due to lack of recent material. Further basic research is required.

***Palaina* (s. l.) *granulum* I. et B. Rensch, 1929**
(Plate 38 figs 13-16, map 28)

Lectotype MHUB [herewith designated]: Zoolog. Museum Berlin [printed] 90945 *Palaina granulum* I.+B. Rensch * Neu-Pommern Weite Bucht Karlei Ig. P. Schneider [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina granulum* I. + B. Rensch Zool. Anz. 80, 1929, p. 86, Abb. 7 [handwritten] [label red].

Paralectotypes 3 adults MHUB [herewith designated]: same labels as lectotype [all paralectotype shells are broken].

Lectotype designation: One of syntypic specimens from „Weite Bucht“ selected as lectotype.

References: Rensch I. & B. (1929: 86); Rensch I. (1937: 604).

Measurements: Lectotype H = 2.1 mm, D = 1.15 mm, HW = 1.25 mm, PD = 1.1 mm. Selected paralectotypes (measurements are identical) H = 2.1 mm, D = 1.2 mm. According to Rensch I. (1937), some specimens of *P. granulum* grow up to H = 2.6 mm, D = 1.4 mm.

Description: Shell is small, whitish to brownish, sinistral, cylindrical with flattened apex. Shell

with 6¼ convex whorls, the 1¾ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a short and shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse straight ribs; the ribs are denser on early whorls, widely-spaced on younger whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls. The ribs range from straight to slightly oblique to the coiling axis. There are about 17-18 ribs per 1 mm. The ribs becoming more widely-spaced on the last half whorl. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick in lateral view and consists of several dense lamellae. The parietal margin of the peristome is attached to the ultimate whorl. Peristomal margins are not sinuous. The inner peristome forms a continuous polished callus. The outer peristome expands beyond the inner one except on the parietal side. The basal margin of the outer peristome is slightly reflexed. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. New Britain Island was initially covered by primary lowland to mid montane rainforests.

Distribution: Bismarck Archipelago: New Britain Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 145000 km² taking into account the area of New Britain, New Ireland and adjacent islets. This species is known from specimens sampled about 100 years ago from two localities and has not been collected again. The population size and trend for *P. granulum* are unknown, however Rensch I. (1937) stated that this species was found in large number. Threats for this species are unknown. Further basic research is required.

***Palaina* (s. l.) *hartmanni* sp. nov.** (Figs 58, 122-123, plate 38 figs 17-22, map 21)

<http://zoobank.org/F245E03C-3188-4997-AD92-85E553DB4B7A>

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 3 km W, 00°26'04"S, 130°47'41"E, 40-50 m, 17.II.2012, secondary lowland rainforest on lime-



stone, leg. D.Telnov.

Paratypes 49 adults: 9 NME & 13 KGC: same label as holotype; 11 adults NME & 16 adults KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4,5 km SW, Waiwo dive resort, 00°26'07"S, 130°46'45"E, 10-15 m, 21.II.2012, primary lowland rainforest on limestone, leg. D.Telnov [one adult is badly broken].

Derivatio nominis: Patronymic. This species is named after well-known Himalaya biodiversity researcher, coleopterist, director of the Naturkundemuseum Erfurt and my good friend Matthias Hartmann.

Measurements: Holotype H = 1.75 mm, D = 1 mm, HW = 0.8 mm, PD = 0.8 mm. Selected paratype specimens: H = 1.8 mm, D = 1 mm, HW = 0.8 mm, PD = 0.8 mm; H = 1.7 mm, D = 1 mm, HW = 0.85 mm, PD = 0.8 mm; H = 1.7 mm, D = 1.05 mm, HW = 0.95 mm, PD = 0.75 mm.

Description: Shell is very small, whitish, yellowish or creamy coloured, sinistral, cylindrical with flattened apex. Shell with 5½ convex whorls, the 1¼ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction defined by reduction of axial ribs (the ribs are absent or very low at this area) and by presence of a flat cavity-like impression on the suture above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse rather dense straight or slightly sinuous ribs. There are abrupt changes in the ribbing pattern - the ribs becoming 3-4x more distant and stronger on tuba. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9 ribs per 0.5 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, consists of several strong lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The palatal margins of both peristomes are sinuous. In fully grown specimens the median part of the palatal margin of the outer peristome is reflexed. The columella is smooth and thin. The operculum is derivative - in a form of a flying disc with slightly raised margin.

Differential diagnosis: This species is distinctive due to very distant axial ribs of the last half

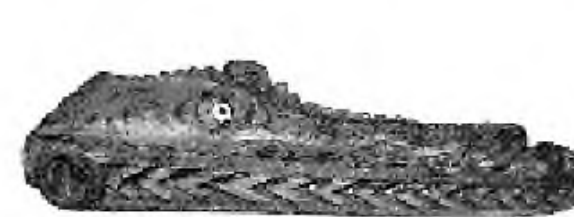
whorl. Similar *Palaina sparselamellata* sp. nov. (Waigeo Island; see description of this species below) differs in all the teleoconch whorls covered with very widely-spaced ribs and in operculum provided with a ridge and generally slightly larger shell size than in *P. hartmanni* sp. nov.

Phylogeny: According to results of COI analysis this species represents a separate clade together with another Waigeo species *P. megalostoma* sp. nov.

Ecology: Specimens found in secondary lowland rainforest at altitudes 40-50 m about 150 m from the seashore, in thick stratum of leaf litter accumulated at buttress roots of large trees and near limestone outcrops in very wet places.

Distribution: Raja Ampat Islands: Waigeo Island.

Conservation status: Near Threatened, NT. This species inhabits western peninsula of Waigeo, it is hitherto recorded from single locality in southern part of it. Not enough data available to calculate current EOO. The maximum EOO estimated under 5000 km² (the area of Waigeo and adjacent islets considering available habitat). The current AOO is 8 km², but the maximum AOO estimated up to 500 km² considering available habitat. The population size is unknown, but *P. hartmanni* sp. nov. is rather abundant. This species is connected with wet rainforest litter. The main threats for this species is Habitat loss and alteration due to conversion of the rainforests into gardens, road construction, timber collecting and small-scale logging resulting in habitat alteration, causing fragmentation and decline in AOO. Growing human population of southern Waigeo and increasing tourism in this area (both national and international) demand more gardens, infrastructure and tourism resorts. Waigeo got a regency capital of Raja Ampat administrative province some years ago. This resulted in boosting development, investments into provincial airport and Waisai, the regency capital. Waigeo is initially rich in limestone rocks and limestone is widely used for roads and buildings construction. Growing population (partly a result of immigration from other islands of Indonesia) requires more firewood and charcoal. Illegal logging is rare but is a reality to count with. Aforementioned factors resulted in decline of primary lowland rainforests, especially in SW Waigeo. This trend is observed, estimated and likely to continue. Between 2001-2014 south-western Waigeo lost just about 1100 ha of rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), but almost exactly in the area where *P. hartmanni* sp. nov. occurs. This species was observed in a disturbed forest with closed



canopy (wet litter is the key). Additional research is required to clarify distribution and highlight population trend for *P. hartmanni* sp. nov. It is important to clarify is this species distributed all over Waigeo Island or is limited to southern part of it.

***Palaina* (s. l.) *iha* sp. nov.** (Figs 60, 100, 106 & 124, plate 38 figs 23-25, map 24)

<http://zoobank.org/AA450A84-B6A4-43F0-9709-4BE3695A6672>

Holotype NME: INDONESIA E, West Papua, Onin Peninsula, Fak-Fak 5-7 km N, 2°53'26"S, 132°18'22"E, 300-400 m, 23.IX.2010, primary lowland rainforest on limestone, leg. D.Telnov.

Paratype 1 adult KGC: same label as holotype.

Derivatio nominis: Named after Iha, local tribe and language of western Onin Peninsula, the area where this species was found. Noun in apposition, invariable.

Measurements: Holotype H = 1.4 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.55 mm. Paratype H = 1.35 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.5 mm.

Description: Shell is very small, white, sinistral, cylindrical with flattened apex. Shell with 5½ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is constricted, nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is delimited by a short zone free of axial ribs and suture impressed above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with rather widely-spaced straight (in paratype) or sinuous (in holotype) ribs. The ribs becoming about twice more distant on tuba. There are no abrupt changes in the ribbing pattern ex-

cept the short discontinuation at the constriction place (see above). The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 14-16 ribs per 0.5 mm. Spiral striae are distinct, very delicate and dense (there are 8-9 rows of spiral striae per 30 µm measured above the aperture). The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly double. Few inconspicuous flat lamellae present between the inner and the outer peristomes. The outer peristome is stronger developed than the inner one. The parietal margin of the peristome is attached to the ultimate whorl. The margins of the peristome are not sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columella is glass-like semitransparent. The operculum is primitive, circular without concentric lines of ridges.

Differential diagnosis: This species is similar to several minute Papuan *Palaina*. Its specific characters are discussed in table 13.

Ecology: This species occurs in primary lowland rainforests.

Distribution: New Guinea: Onin Peninsula.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The current AOO is 4 km² but likely is much higher. *Palaina iha* sp. nov. is known from two specimens collected at one locality in primary lowland rainforest. Threats for this species cannot be identified. Onin Peninsula is still very pristine and covered by primary rainforests for over 75%. Further research is required on distribution of this species as well as on population size and threats.

Table 13. Papuan species of *Palaina* s. l. similar to *P. iha* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. iha</i> sp. nov.
<i>Palaina albrechti</i> sp. nov.	no interruption in ribbing pattern at the constriction	a short zone free of axial ribs at the constriction
<i>P. biroi</i>	the operculum with low concentric ridges and shallow median impression on the outer surface	the operculum without ridges and impression
<i>P. flavocylindrica</i> sp. nov.	axial ribbing pattern not discontinued at the constriction	a short zone free of axial ribs at the constriction
<i>P. insulana</i> sp. nov.	H = 1.8-1.95 mm, axial ribbing pattern not discontinued at the constriction, the peristome is triple, rather broad in lateral view and consists of dense lamellae, the outer peristome not or slightly stronger than the inner one	H = 1.35-1.4 mm, short zone free of axial ribs at the constriction, few flat lamellae between the inner and the outer peristome, the outer peristome stronger than the inner one



<i>P. lengguru</i> sp. nov.	there are abrupt changes of the axial ribbing pattern - starting from the constriction the ribs becoming coarser and 2x more widely-spaced on the last half whorl	axial ribbing pattern changes evenly starting from the constriction
<i>P. minuscularia</i> sp. nov.	axial ribs delicate and rather low, about 25-28 ribs per 0.5 mm, the columella with basal knob, 4 rows of spiral striae per 30 µm (measured above the aperture), axial ribbing pattern is not discontinued at the constriction	axial ribs rather high and coarse, about 14-16 ribs per 0.5 mm, the columella a simple lamella, 8-9 rows of spiral striae per 30 µm (measured above the aperture), a short zone free of axial ribs at the constriction
<i>P. waigeo</i> sp. nov.	5-6 rows of spiral striae per 30 µm (measured above the aperture), axial ribbing pattern not discontinued or discontinued (in one paratype) at the constriction, there are abrupt changes in the ribbing pattern - starting from the constriction the ribs becoming coarser and twice more distant	8-9 rows of spiral striae per 30 µm (measured above the aperture), a short zone free of axial ribs at the constriction, axial ribbing pattern changes evenly starting from the constriction

***Palaina* (s. l.) *imperfecta* sp. nov.** (Fig. 61, plate 47
figs 14-16, map 20)

<http://zoobank.org/A9C1B5A1-F821-40C5-A3CB-ED56DDF479D8>

Holotype LKCNHM: Indonesia: West Papua [sic!], Waigeo, Lopintol, Gua Kalepale, Leg. T. Whitten, Jan 2013.

Derivatio nominis: Named from Latin “imperfectus” [not perfect, not finished] since this species is small and was only represented with a single specimen for this study.

Measurements: Holotype H = 1.75 mm, D = 1.2 mm, HW = 1 mm, PD = 0.7 mm.

Description: Shell is very small, yellowish, sinistral, cylindrical with conical apex. Shell with 5¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is strongly constricted, ascending; it is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The protoconch is placed oblique on the rest of the shell. The constriction is well defined by deeply impressed suture above the constriction and by a zone of twice denser axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced straight axial ribs. The ribs becoming twice sparser on the two last whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9-10 ribs per 0.5 mm. Spiral striae are lacking at 80x magnification. The aperture is not of slightly tilted to the coiling axis and is ovoid and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is triple, thick in lateral view. The parietal margin of the peristome is

attached to the ultimate whorl. The inner peristome forms a broad continuous polished callus, with two obtuse ear-like protrudings near the palatal / parietal and the parietal / columellar junctions. Both the palatal and columellar margins of the inner peristome are sinuous. The columella is smooth. Operculum is unknown.

Differential diagnosis: This species is most closely related with *P. laszloi* sp. nov. (Wayag Island NW of Waigeo) and *P. wawiyai* sp. nov. (Waigeo Island), but differs primarily in much smaller shell and in simple columella which is not widened and not provided with a knob.

Ecology: Unknown.

Distribution: Raja Ampat Islands: Waigeo Island. Co-ordinates of Gua [cave] Kalepale are 00°17'18"S, 130°49'15"E, but no information is available where exactly this specimen was sampled.

Conservation status: Data Deficient, DD. This species is known from single specimen collected under unknown circumstances and the habitat is unknown. Not enough data available to calculate current EOO. The maximum EOO estimated over 65 km² taking into account the Lopintol vill. and adjacent area of West Waigeo. The current AOO is 4 km², the maximum AOO is certainly under 500 km². The population size and trend are unknown. Threats for this species are unknown. Further research is required primarily on distribution and habitat requirements of *P. imperfecta* sp. nov.

***Palaina* (s. l.) *inconspicua* van Benthem Jutting, 1963** (Plate 38 figs 29-31, map 27)

Holotype NMNL: Papua, Biak, Zuid-Biak, Owi, Brongersma & Roosdorp, 1952.04.06.

References: van Benthem Jutting (1963: 708, pl.



29 fig. 30).

Measurements: Holotype H = 2.7 mm, D = 1.7 mm, HW = 1.5 mm, PD = 1.3 mm. Selected paratype specimens (according to the original description): H = 2.5 mm, D = 1.5 mm, PD = 0.9 mm; H = 2.7 mm, D = 1.6 mm, PD = 1.2 mm.

Description: Shell is small, whitish to brownish, sinistral, obese with flattened apex. Shell with 5 strongly convex whorls, the 1 embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted and slightly ascending; it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a broad shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense straight ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 13-14 ribs per 1 mm. The ribs becoming more widely-spaced on the last half whorl. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick and consists of numerous dense lamellae in lateral view. The parietal margin of the peristome is completely attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus which expands and covers about a half of the ultimate whorl in apertural view. Peristomal margins are not sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown.

Distribution: Cenderawasih Bay: Owi Island. Possibly extant also on Biak Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated 7800 km² taking into account the area of Owi, Biak, Supiori, Numfoor and adjacent islets. The maximum AOO estimated less than 500 km². This species is known from a series of specimens sampled about 70 years ago from single locality. Cenderawasih Bay islands are widely known by high proportion of endemic molluscs (e.g. van Benthem Jutting 1963). No information is available on the population size and trend. Threats for this species are unknown. Habitat loss and alteration considered important threats but cannot be validated, because of lack of data. Further basic research activities are required.

***Palaina* (s. l.) *insulana* sp. nov.** (Figs 62, 125-126, plate 38 figs 26-28, map 17)

<http://zoobank.org/1F2BD7C6-E21B-47D9-BB31-8E6B2F32D4A6>

Holotype NME: INDONESIA E, Prov. Raja Ampat, distr. Misool Barat, Lilinta (Lelintah) vill. ~16 km S, Polee (Yf-polee) Island, 02°11'56"S, 130°16'19"E, 02.IV.2009, primary lowland rainforest, leg. K.Greke.

Paratypes 2 adults & 1 juv. KGC: same label as holotype [one adult is badly broken].

Derivatio nominis: This species was found on a small Polee islet and therefore is named from Latin 'insula' [island].

Measurements: Holotype H = 1.95 mm, D = 1 mm, HW = 1.05 mm, PD = 0.8 mm. Selected paratype specimen: H = 1.8 mm, D = 0.95 mm, HW = 1 mm, PD = 0.7 mm.

Description: Shell is very small to small, white, sinistral, high cylindrical with flattened apex. Shell with 6 convex whorls, the 2 embryonic whorls are microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by a sutural impression above the constriction. The constriction situated on same axis with the columellar side of the aperture. Teleoconch sculpture on the first 3-4 whorls consists of delicate dense straight ribs. The ribs becoming much coarser and twice more distant on two last whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 8-9 ribs per 0.5 mm. Spiral striae are lacking at 80x magnification. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly triple, thick in lateral view and consists of two large and several delicate lamellae. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. The palatal margin of the outer peristome is slightly sinuous. The columella is shiny and straight. Operculum is unknown.

Differential diagnosis: Most closely related with *Palaina minuscularia* sp. nov. (Misool Island; see description and differential diagnose of this species below). Also conchologically similar with *P. beilanensis* Preston, 1913 (North Moluccas) from *P. insulana* sp. nov. differs primarily in laterally thicker peristome (in *P. beilanensis* the peristome



is less thick in lateral view), sparser axial ribs on the penultimate and the ultimate whorls and shell less than twice higher than wide (shell is twice higher than wide in *P. beilanensis*).

Ecology: This species occurs in primary lowland rainforests on limestone rocks. Specimens observed in wet leaf litter accumulated in cavities of limestone formations, about 20 m from the sea shore.

Distribution: Raja Ampat Islands: Polee (= Pelee, Yfpolee) Island south of Misool.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO estimated below 2000 km² taking into account the area of Misool Island and adjacent islets. The current AOO is 4 km². The maximum AOO is likely higher. The population size and trend are unknown. *Palaina insulana* sp. nov. is not an abundant species even at its type locality. This species is currently known from single locality and inhabits old-growth lowland rainforests on limestone rock formations. No major threats have been identified for this species. Polee Island is very small (about 1500 ha) and partly consists of pure limestone rocks with no forest on them; it is uninhabited and only rarely visited by fishermen and turtle eggs collectors from S Misool. The islet is very pristine and covered by primary rainforests. Further research is required on distribution of *P. insulana* sp. nov. as well as on population size, trend and threats.

***Palaina* (s. l.) *laszloi* sp. nov.** (Fig. 63, plate 39 figs 1-4, map 20)

<http://zoobank.org/884177F1-754E-43C3-BDB2-7C728D2021EE>

Holotype NME: INDONESIA E, Raja Ampat Prov., Wayag Island, along the southern coast, 31.X.2011, leaf debris in forest at the foot of limestone cliff, leg. L. Wagner.

Paratype 1 KGC: same label as holotype.

Derivatio nominis: Patronymic. This species devoted to Laszlo Wagner (Budapest, Hungary; <http://www.east-indonesia.info>), my friend and famous Indonesia explorer who first collected this species.

Measurements: Holotype H = 2.3 mm, D = 1.4 mm, HW = 1.15 mm, PD = 1 mm. Paratype specimen: H = 2.1 mm, D = 1.3 mm, HW = 1.1 mm, PD = 1 mm.

Description: Shell is small, yellow, sinistral, broadly fusiform with conical apex. Shell with 5³/₄-5¹/₄ convex whorls, the 1¹/₂-1¹/₄ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is strongly constricted, ascending, nearly as wide as the penultimate whorl

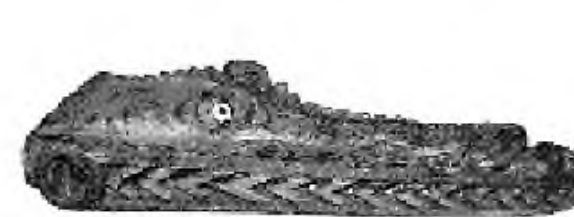
in apertural view. The umbilicus is closed in adult. The protoconch is placed oblique on the rest of the shell. The constriction is well defined by a short zone of less coarse (low) axial ribs and sutural impression above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse, widely-spaced, straight axial ribs. The ribs becoming stronger (more high) and lamella-like on the suture. There are no abrupt changes in the ribbing pattern. The ribs are partly synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9-10 ribs per 1 mm. Spiral striae are lacking at 80x magnification. The aperture is not of slightly tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick in lateral view. There is a zone of very dense flat lamellae between the inner and the outer peristome. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus. Two distinct obtuse ear-like protrudings developed at the palatal / parietal and the parietal / columellar junctions. Both the palatal and columellar margins of the inner peristome are strongly sinuous, of the outer peristome - slightly sinuous. The outer peristome is broadly discontinued parietally. The columella is smooth, provided with a very large knob in basal half (this knob is becoming stronger at base of the columella). The operculum is derivative - circular with a long and medially hollow tube on the outer surface.

Differential diagnosis: This species is distinctive among all congeners due to the combination of the following characters: the inner peristome with two distinct ear-like protrudings (similar like in *Palaina scaveola* van Benthem Jutting, 1958 (Misool Island) and *P. sparselamellata* sp. nov. (Waigeo Island; see description of this species below), the columella is provided with a large median knob. Also very similar with *P. wawiyai* sp. nov. (Waigeo Island) - see description and differential diagnosis of this species below.

Ecology: This species occurs in primary lowland rainforests at base of the karst hills Wayag is so famous with.

Distribution: Raja Ampat Islands: Wayag Island.

Conservation status: Data Deficient, DD. This species is known from two specimens recently collected on a small and rugged limestone islet covered with primary semidry vegetation. Not enough data available to calculate current EOO. The maximum EOO estimated about 1850 km² taking into



account the area of Wayag, adjacent islets and NW Waigeo. The current AOO is 4 km², the maximum AOO is certainly under 500 km². Threats are unknown as the population size and trend are. Further basic research is required.

***Palaina* (s. l.) *lengguru* sp. nov.** (Figs 65-66, 101 & 104, plate 39 figs 5-11, map 24)

<http://zoobank.org/724DAB2A-23BC-4A2C-A394-630747635C99>

Holotype NME: INDONESIA E, West Papua, S Bird's Neck, Kaimana 40 km E, Triton Bay, Lobo vill. & env., 3°45'33"S, 134°06'11"E, 15-150 m, 11-12.IX.2010, primary rainforest on limestone, leg. K.Greke.
Paratypes 59 adults KGC, 20 adults NME, 2 LKCNHM & 3 SMF: same label as holotype.

Derivatio nominis: Toponymic. This species was discovered in vast rainforests of Lengguru river valley and is named after this scenic river. Noun in apposition, invariable.
Measurements: Holotype H = 1.35 mm, D = 0.75 mm, HW = 0.75 mm, PD = 0.6 mm. Selected paratypes: H = 1.4 mm, D = 0.8 mm, HW = 0.75 mm, PD = 0.6 mm; H = 1.35 mm, D = 0.8 mm, HW = 0.7 mm, PD = 0.6 mm; H = 1.35 mm, D = 0.75 mm, HW = 0.8 mm, PD = 0.6 mm; H = 1.3 mm, D = 0.75 mm, HW = 0.75 mm, PD = 0.6 mm; H = 1.3 mm, D = 0.75 mm, HW = 0.7 mm, PD = 0.6 mm.
Description: Shell is very small, white with yellow body, sinistral, cylindrical with flattened apex. Shell with 4¾-5 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The penultimate whorl is constricted, as wide as the ultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short discontinuation in axial ribbing

pattern and presence of sutural impression above the constriction. The constriction situated on same axis with the columellar side of the aperture. In most specimens the protoconch is placed oblique on the rest of the shell. The teleoconch is sculptured with delicate dense slightly sinuous axial ribs. There are abrupt changes in the ribbing pattern - the ribs becoming coarser and twice more distant starting from the constriction. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 13-15 ribs per 0.5 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The outer peristome is expanding beyond the inner one. The parietal margin of the peristome is attached to the ultimate whorl. Peristomal margins are not sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columella is thin and straight, widening basally towards columellar plate. In certain specimens the columella is visible at the columellar margin of the peristome in a form of an inconspicuous callus. The operculum is derivative - in a form of a flying disc, with slightly raised margin and without concentric ridges.
Differential diagnosis: This species is similar to several minute Papuan *Palaina*. Specific characters are presented in the table 14.
Ecology: This species occurs in primary lowland rainforests at altitudes from sea level up to 150 m. Specimens were observed in wet leaf litter and under decaying wood at base of limestone outcrops.

Table 14. Papuan species of *Palaina* s. l. similar to *P. lengguru* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. lengguru</i> sp. nov.
<i>Palaina albrechti</i> sp. nov.	axial ribbing pattern changes evenly starting from the constriction	there are abrupt changes in the axial ribbing pattern - starting from the constriction the ribs becoming coarser and 2x more distant
<i>P. beilanensis</i>	shell 2x higher than broad, H ~1.8-2 mm	shell less than 2x higher than broad, H ~1.1-1.3 mm
<i>P. insulana</i> sp. nov.	H ~1.8-1.95 mm, the peristome is rather broad in lateral view, it is triple and consists of several dense lamellae	H ~1.3 mm, the peristome is double, thin in lateral view and consists of a few lamellae
<i>P. biroi</i>	the operculum with low concentric ridges and shallow median impression on the outer surface	the operculum without concentric ridges and without median impression
<i>P. iha</i> sp. nov.	axial ribbing pattern changes evenly starting from the constriction	there are abrupt changes in the axial ribbing pattern - starting from the constriction the ribs becoming coarser and 2x more distant



<i>P. waigeo</i> sp. nov.	shell generally higher, W = 5½, axial ribs denser and slightly oblique to the coiling axis, the outer peristome is comparatively stronger expanded, the columella is not widening basally	shell generally lower, W = 4¾-5, axial ribs more widely-spaced and stronger oblique to the coiling axis, the outer peristome is comparatively less strongly expanded, the columella widening basally
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Distribution: New Guinea: southern part of Bird's Neck Isthmus.
Conservation status: Least Concern, LC. Not enough data available to calculate current EOO. The maximum EOO for this species is estimated about 19000 km² taking into account the area of Bird's Neck Isthmus of New Guinea and available habitat. The current AOO is 8 km², the maximum AOO estimated between 500-2000 km² taking into account available habitat, soil types and biogeographical peculiarities of Bird's Neck. The population size and trend are unknown, but this species is locally very abundant. Habitat loss and alteration are the main threats. On southern Bird's Neck coastal areas are being converted into gardens and settlements are slowly expanding, but steep anticlines are still all covered with primary forest. The forested part of the maximum EOO is stable. Continuing decline in extent and quality of habitat is observed and projected in synclines of Bird's Neck but this trend likely will not affect anticlines. Significant decline in AOO or EOO cannot be projected for this species for next 10 years. Additional research is required on distribution, population size and trend for *P. lengguru* sp. nov. Threats for this species to be clarified. Terrestrial nature conservation area should be created in order to protect local fauna of southern Bird's Neck.

***Palaina* (s. l.) *leptotoreutos* van Benthem Jutting, 1958** (Plate 39 figs 12-14, map 16)
Holotype NMNL: Papua, Misoöl, Fakal, 0-75 m, M.A. Lieftinck, 10.07.1948.

References: van Benthem Jutting (1958a: 314); van Benthem Jutting (1963: 703).
Measurements: Holotype H = 3 mm, D = 1.8 mm, HW = 1.8 mm, PD = 1.4 mm. Selected paratypes (according to the original description) H = 2.5 mm, D = 1.5 mm, PD = 1.2 mm; H = 2.8 mm, D = 1.6 mm, PD = 1.3 mm; H = 3.2 mm, D = 1.6 mm, PD = 1.5 mm.
Description: Shell is large, yellowish, sinistral, cylindrical with flattened apex. Shell with 5½ strongly convex whorls, the 1¾ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, ascending, as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction

is poorly defined by a short zone of more distant axial ribs. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with coarse dense straight ribs. The ribs becoming distinctly more widely-spaced on the ultimate whorl. There are abrupt changes in the ribbing pattern (see above). The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 17-18 ribs per 1 mm, but about 10-11 per 1 mm on the apertural side above the aperture. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick and consists of numerous dense lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The columellar margin of the inner peristome is sinuous. The inner peristome forms a very broad continuous polished callus which expands and covers about a half of the ultimate whorl in apertural view. The outer peristome is discontinued parietally. The palatal margin of the outer peristome is sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.
Ecology: Unknown. Misool Island is covered by primary lowland rainforests, mostly on limestone soils.
Distribution: Raja Ampat Islands: Misool Island.
Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated below 2000 km² taking into account the area of Misool and available habitat. The maximum AOO estimated much higher but below 500 km². The population size and trend are unknown. No recent material is available on this species. Further research is required to clarify status of this species in the wild, measure the population and highlight threats.

***Palaina* (s. l.) *liliputana* van Benthem Jutting, 1963** (Plate 39 figs 15-17, map 27)
Holotype NMNL: Papua, Biak, A. Hollander, Dec. 1952.

References: van Benthem Jutting (1963: 710, plate 30 fig. 32).
Measurements: Holotype H = 2.1 mm, D = 1.2



mm, HW = 1.1 mm, PD = 1 mm. Selected paratypic specimens (according to the original description): H = 2.3 mm, D = 1.2 mm, PD = 1 mm; H = 2.1 mm, D = 1.2 mm, PD = 0.8 mm.

Description: Shell is very small, creamy-coloured, sinistral, obese with conical apex. Shell with $5\frac{1}{4}$ strongly convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted and slightly ascending, it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by presence of a broad shallow impression and a sutural impression above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with fine dense straight ribs. The ribs becoming slightly more distant on the last half whorl, but are inconspicuously denser at the constriction. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 10 ribs per 0.5 mm. Spiral striae are very delicate. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick and consists of numerous dense lamellae in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The palatal margin of the inner peristome is slightly sinuous. The inner peristome forms a very broad continuous polished callus which expands and covers up to a half of the ultimate whorl. The outer peristome is as wide as the penultimate whorl in apertural view. The margins of the outer peristome are not sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Specimens found in soil.

Distribution: Cenderawasih Bay: Biak Island. Paratypic specimen from Onin Peninsula (Kokas env.) belongs to hitherto undescribed species which is different primarily in the parietal margin of the peristome pressed against the ultimate whorl (not pressed in *P. liliputana*), the palatal margin of the peristome being straight (it is sinuous in *P. liliputana*), less thick peristome in left lateral view and the ultimate whorl being ascending and covering less than a half of the ultimate whorl in apertural view (the ultimate whorl is slightly ascending in *P. liliputana*). Single specimen from env. Kokas is broken and no additional material is available, therefore this species is not described in this work. **Conservation status:** Data Deficient, DD. Not

enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 7800 km² taking into account the area of Biak, Supiori, Numfoor and adjacent islets. The maximum AOO is definitively below the threshold of 500 km². This species is known from specimens sampled about 70 years ago and has not been collected again. Biak is widely known by high proportion of endemic molluscs (e.g. van Benthem Jutting 1963). The population size and trend for *P. liliputana* is unknown. Threats for this species are unknown. Further research is required to uncover present status of this species in the wild, measure its population size and highlight threats.

***Palaina* (s. l.) *louiade* sp. nov.** (Fig. 59, plate 39 figs 18-23, map 25)

<http://zoobank.org/13849282-8A0D-4015-AA93-7BD47D28A95E>

Holotype UF (No 342882): UF 342882 Diplommatiniidae 1 specimen(s) *Palaina* [printed] sp3 [handwritten] Papua New Guinea, Milne Bay Province Misima island, Kaubwaga Primary School at Genisia Creek stream, on limestone blocks 40 meters 10.64615° S 152.83793° E Slapcinsky, J. D. 08-April-04 JS-0703 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 342882 [printed] / UF 342882 [handwritten].

Paratypes 2 specimens UF: 1 subadult: same labels as holotype; 1 adult UF: 340953 Diplommatinidae 2 specimen(s) [sic! only one specimen available] *Palaina* Papua New Guinea, Milne Bay Province Misima island, Kaubwaga Primary School at Genisia Creek stream, on limestone blocks 40 meters 10.64615° S 152.83793° E Slapcinsky, J. D. 08-April-2004 JS-0703 drowned in water > 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / *Palaina* 703 [handwritten].

Derivatio nominis: Toponymic. This species named after Louisiade Islands southeast of New Guinea where it occurs. Noun in apposition, invariable.

Measurements: Holotype H = 2.4 mm, D = 1.3 mm, HW = 1.4 mm, PD = 1 mm. Paratypic specimens: H = 2.45 mm, D = 1.2 mm, HW = 1.3 mm, PD = 1 mm; H = 2.2 mm, D = 1.1 mm, HW = 1.2 mm, PD = 0.8 mm [subadult specimen].

Description: Shell is small, white or creamy, sinistral, cylindrical with conical apex. Shell with $5\frac{1}{2}$ convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The protoconch is placed oblique on the rest of the shell. The ultimate whorl is constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is very poorly defined by a shallow impression and a zone



of denser placed axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight or slightly sinuous ribs. There are abrupt changes in the ribbing pattern - the ribs becoming much coarser and 2-2.5x more distant on tuba. The ribs are partially synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 12-14 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is slightly shifted left against the coiling axis in apertural view. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The palatal margins of both peristomes are slightly sinuous. The inner peristome forms a continuous polished callus which is discontinued parietally. The outer peristome is broadly discontinued parietally. The columella is shiny and thin, slightly curved. The operculum is derivative, circular and transparent, with low concentric ridges and vague median impression on the outer surface.

Differential diagnosis: Most closely related with *Palaina adelpha* Soós, 1911 (Eastern New Guinea), *P. flavocylindrica* sp. nov. (Bird's Neck Isthmus of New Guinea; see description of this species above) and *P. psittricha* sp. nov. (Misool Island; see description of this species below). The operculum is simple (without concentric ridges) in *P. lousiade* sp. nov. (it is high, consists of concentric ridges in both *P. adelpha* and *P. psittricha* sp. nov.). The columella is significantly broader in *P. flavocylindrica* sp. nov. and *P. psittricha* sp. nov. than in *P. lousiade* sp. nov. The peristome is significantly narrower in lateral view in *P. lousiade* sp. nov. than in *P. psittricha* sp. nov. The axial ribs are generally less prominent in *P. lousiade* sp. nov. than in *P. adelpha*.

Ecology: Specimens collected from limestone formations near streams at low altitudes.

Distribution: Lousiade Islands: Misima Island. One badly broken specimen from Rossel Island in UF collection possibly also belongs to this species.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO estimated below 5000 km² taking into account the area of Lousiade Islands and available habitat. The current AOO is 4(8) km² (see note on Rossel Island record above). The maximum AOO is likely higher but estimated below the threshold of 500 km². The population size and trend are unknown. Threats for this species are unknown. Further research is required on distribution of this species, its population size and threats.

***Palaina* (s. l.) *mairasi* sp. nov.** (Fig. 67, plate 39 figs 24-32, map 25)

<http://zoobank.org/811642AE-5DEA-4AE7-9BB8-DA5657A19610>

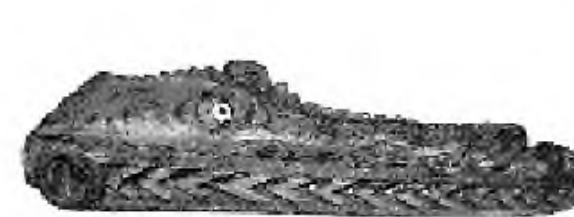
Holotype NME: INDONESIA E, West Papua, S Bird's Neck, Kaimana 47 km E, Triton bay, Kamaka (former Warika) vill. env., Lake Kamakawalar and surroundings, 3°46'22"S, 134°12'02"E, 60-310 m, 08.IX.2010, primary lowland rainforest, leg. K.Greke.

Paratypes 224 specimens: 56 adults, 17 subadults & 55 juv. KGC, 33 adults & 20 juv. NME, 2 LKCNHM, 2 SMF: same label as holotype; 30 adults KGC, 7 adults & 2 subadults NME: INDONESIA E, West Papua, S Bird's Neck, Kaimana 40 km E, Triton bay, Lobo vill. & env., 3°45'33"S, 134°06'11"E, 15-150 m, 11-12.IX.2010, secondary & primary rainforest on limestone, leg. K.Greke.

Derivatio nominis: Named after Mairasi, a local tribe and language of southern Bird's Neck of New Guinea. Noun in apposition, invariable.

Measurements: Holotype H = 3.7 mm, D = 2.3 mm, HW = 1.9 mm, PD = 1.8 mm. Selected paratype specimens from type locality: H = 4.1 mm, D = 2.3 mm, HW = 2.1 mm, PD = 1.9 mm; H = 3.95 mm, D = 2.3 mm, HW = 2 mm, PD = 1.8 mm; H = 3.7 mm, D = 2.1 mm, PD = 1.9 mm; H = 3.7 mm, D = 2 mm, PD = 1.7 mm. Selected paratype specimens from Lobo env.: H = 3.4 mm, D = 2 mm, HW = 1.75 mm, PD = 1.5 mm; H = 3 mm, D = 1.8 mm, HW = 1.5 mm, PD = 1.4 mm; H = 2.8 mm, D = 1.6 mm, PD = 0.8 mm.

Description: Shell is large, white, yellow to pale brown, dextral, obese cylindrical with conical apex. W = 6-6¼, very convex, of them 1.5 microscopically pitted embryonic whorl. The suture is rather deeply impressed. The ultimate whorl is constricted and slightly ascending, in apertural view not or slightly narrower than the penultimate whorl. The umbilicus is closed in adult. The constriction is well defined by presence of a shallow and broad impression, deeply impressed suture above the constriction and a zone of denser placed axial ribs. The constriction is more or less centered in apertural view. With an inconspicuous bulb just beyond the constriction above the columellar side of the aperture. The teleoconch is sculptured with delicate, dense, slightly sinuous ribs. The ribs becoming coarser and somewhat more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 11-13 ribs per 1 mm. Spiral striae delicate, very dense. The aperture deeply impressed suture over the constriction area, circular,



rarely oval, apertural rim is entire. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The parietal margins of the peristome are attached to the ultimate whorl. Palatal and columellar margins of both peristomes are sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columella is smooth, straight and moderately broad. The operculum is derivative - in a form of a flying disc, with raised margin and concentric ridges on the outer surface.

Differential diagnosis: Most closely related *Palaina novoguineensis* E.A. Smith, 1897 (Onin Peninsula and Bird's Neck Isthmus of New Guinea), differs specifically in less conspicuous bulb (conspicuous, angulate projecting in *P. novoguineensis*), straight columella (the columella is slightly curved in *P. novoguineensis*), and in operculum with raised margin and without concentric ridges (operculum with several concentric ridges in *P. novoguineensis*).

Ecology: This species occurs in primary and secondary lowland rainforests at altitudes from sea level up to 310 m. Specimens observed in wet leaf litter and under decaying wood at base of limestone outcrops.

Distribution: New Guinea: southern part of Bird's Neck Isthmus.

Conservation status: Least Concern, LC. The current EOO is about 40 km², but maximum EOO for this species is estimated about 19000 km² taking into account the area of Bird's Neck Isthmus of New Guinea and available habitat. The current AOO is 20 km², the maximum AOO estimated between 500-2000 km² considering available habitat and biogeographical peculiarities. Population size and trend are unknown, but this species is very abundant at certain localities. Loss and altering of habitat are the main threats. There are two locations for this species. On southern Bird's Neck, coastal areas being converted into gardens or expanding settlements but steep anticlines are still all covered by primary forest. The forested part of the maximum EOO is quite stable. Continuing decline in extent and quality of habitat is observed and estimated in lowland areas and synclines of Bird's Neck and this trend likely will not affect anticlines. I can't project significant decline of habitat for the next 10 years. Additional research is required on distribution, population size and trend, as well as on threats for this species. Terrestrial nature conservation area should be established in order to protect local fauna of southern Bird's Neck.

***Palaina* (s. l.) *manggaraica* (B. Rensch, 1931) comb. nov.** (Figs 68-69, plate 40 figs 1-9, map 13)

Holotype MHUB: Sunda-Expedition Rensch Fundort: [printed] Ranan Mere [sic!] (12-1300m) W. Flores [handwritten] Datum: [printed] 19.-29.6.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Arinia manggaraica* * Rensch Rana Mere, W. Flores 12-1300m 19.-29 6.27 75448 Rensch leg [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Arinia manggarai-ca* Rensch Zool. Jahrb. Syst., 61, p. 391, Fig. 16, 1931 [handwritten] [label red].

Additional material: 1 adult KGC & 1 adult NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.386'S, 120°31.156'E, 1575 m, 10.III.2011, primary lower montane rainforest, soil sample No 11, leg. A.Riedel; 1 adult KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.714'S, 120°31.509'E, 1850 m, 10.III.2011, primary mid montane rainforest, soil sample No 7, leg. A.Riedel; 1 adult KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.641'S, 120°31.204'E, 1685 m, 10.III.2011, primary lower montane rainforest, soil sample No 9, leg. A.Riedel; 1 adult KGC: INDONESIA, Nusa Tenggara, Flores Is., Golo Lusang, 08°39.875'S, 120°27.596'E, 1565 m, 11.III.2011, primary lower montane rainforest, soil sample No 2, leg. A.Riedel.

New combination: This new combination is based on the results of COI analysis since this species represents same clade with another *Palaina* (see below).

References: Rensch B. (1931: 391), as *Arinia manggaraica*.

Measurements: Holotype H = 2.3 mm, D = 1.25 mm, HW = 1.9 mm, PD = 0.9 mm. Specimens from Mt. Ranaka: H = 3 mm, D = 1.55 mm, PD = 1.3 mm; H = 2.15 mm, D = 1.1 mm, PD = 0.8 mm; H = 2.05 mm, D = 1.2 mm, PD = 0.9 mm. Specimen from Golo Lusang H = 2.05 x 1.1 mm, aperture 0.85 mm. Description: Shell is small, yellowish, whitish or pale brown, dextral, cylindrical with flattened apex. Shell with 5¼-5½ convex whorls, the 1¼ embryonic whorl is smooth (no microscopic sculpture visible at 300x magnification). The suture is deeply impressed. The ultimate whorl is slightly constricted, it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with delicate dense straight axial ribs. The ribs are most dense on the penultimate whorl and becoming coarse and very widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. Spiral striae are lacking at 80x



magnification. The aperture is not or barely tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick and consists of a few strong lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The margins of the inner peristome are not sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally, its palatal margin is slightly sinuous. The columella is glass-like semitransparent, provided with a lateral callus all along its length; this callus is directed backwards. The operculum is derivative-circular, in a form of a flying disc with slightly raised margin and bears concentric lines.

Phylogeny: According to results of COI analysis this species represents a separate clade of *Palaina* species from Lesser Sunda Islands (*P. manggaraica*) and Lease Islands (*P. angulata* O. Boettger, 1891 & *P. ascendens* (Martens, 1867). Proposed new combination is based on the phylogenetic reconstruction.

Ecology: This species inhabits primary lower montane rainforests, where it can be found in leaf litter. Known from altitudes of 1575-1850 m.

Distribution: Lesser Sunda Islands: Flores Island.

Conservation status: Endangered, EN B2ab(ii,iii). The current EOO is about 55 km². The maximum EOO estimated about 15000 km² taking into account the area of Flores Island (13540 km²) and adjacent islands. The current AOO is 12 km² but the real AOO estimated 500 km². This species is underresearched. The population size and trend are unknown, *P. manggaraica* is not abundant. This species avoids arid and deforested lowlands. Three localities are currently known for this species. The population is not severely fragmented, but the grade of fragmentation is likely to increase. The main threats for this species are habitat alteration and destruction due conversion of the rainforest into gardens, timber collecting and small-scale logging. It results in habitat alteration, fragmentation and decline in the AOO. Growing human population of Flores combined with more frequent and longer dry periods caused by global warming and El Niño weather patterns will likely have negative effect on the remaining natural rainforests of Flores. Between 2001 and 2014, Flores, its adjacent islands of Lembata, Adonara, Solor and Rinca lost almost 29000 ha of lowland forest (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Human population is not spreading from lowlands to the montane areas, but wet moun-

tains are threatened by expanding small-scale gardens and logging for construction purposes. This trend is likely to cause a continuing decline in the AOO and extent of the habitat. There are two locations for *Palaina manggaraica*. The human population is not encroaching on the habitat too dramatically yet, but a continuing decline in the near future is projected. Additional research is required on the distribution, population size and threats for *P. manggaraica*.

***Palaina* (s. l.) *megalostoma* sp. nov.** (Fig. 70, plate 40 figs 10-13, map 21)

<http://zoobank.org/B30CA578-4FD5-4594-86B8-54E2EF7DC507>

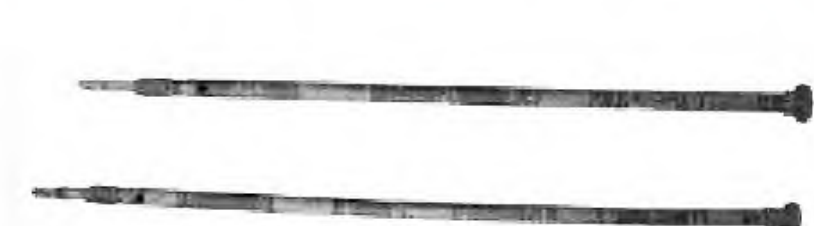
Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10 km NWW, 00°24'46"S, 130°44'11"E, 70-200 m, 19.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 3 specimens: 1 subadult NME, 2 adults & 1 subadult KGC: same label as holotype.

Derivatio nominis: Named from Greek “μεγάλος” [big] and “στόμα” [mouth], because of very large aperture in this species.

Measurements: Holotype H = 4.1 mm, D = 2.7 mm, HW = 2.35 mm, PD = 2.3 mm. Selected paratype specimens: H = 4.25 mm, D = 3 mm, HW = 2 mm, PD = 2 mm; H = 4.1 mm, D = 3 mm, HW = 2.25 mm, PD = 2.1 mm.

Description: Shell is large whitish to pale brown, sinistral, obese with flattened apex. Shell with 6¼ convex whorls, the 1½-1¾ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is constricted, ascending and narrower than the penultimate whorl in apertural view. The umbilicus is narrowly open and perspective. The constriction not delimited on shell wall in fully grown specimens, because most of the ultimate whorl is covered by expanded peristome in apertural view. In subadult specimens the constriction is well defined by denser placed and less coarse axial ribs, presence of a flat impression and suture with a cavity-like impression above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense sinuous axial ribs. The ribs of 3-4 whorls becoming higher (somewhat lamella-like) in their lower parts. The ribs becoming inconspicuously sparser on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 11-12 ribs per 1 mm. Spiral striae are lacking. The



aperture is not tilted against the coiling axis, is oval and has entire apertural. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple. Numerous very dense lamellae present at the very end of the ultimate whorl prior to the peristome. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus, strongly expands in fully grown specimens and covers most of the ultimate whorl in apertural view. The palatal margin of the peristome is slightly sinuous. The columella is very broad and smooth with a large triangular median knob which is directed backwards. The operculum is derivative - circular, with concentric ridges on the outer surface.

Differential diagnosis: A very distinctive species among all congeners due to the combination of the following characters: shell obese, umbilicus open and perspective, the inner peristome very strongly expands and covers most of the ultimate whorl in apertural view.

Phylogeny: According to results of COI analysis this species represents a separate clade together with another Waigeo species *P. hartmanni* sp. nov.

Ecology: Specimens were sampled from underside of large fallen leaves in primary lowland rainforest on limestone soil in a flat low area which overflows during heavy rains.

Distribution: Raja Ampat Islands: Waigeo Island
Conservation status: Near Threatened, NT. This species inhabits western peninsula of Waigeo Island and is hitherto recorded from single locality. Not enough data available to calculate current EOO. The maximum EOO estimated under 5000 km² taking into account the area of Waigeo and adjacent islets. The current AOO is 4 km², but the maximum AOO estimated below 500 km² taking into account available habitat. The population size is unknown, but the species is uncommon compared to another Waigeo diplommatinids. Habitat loss is the main threat. Growing human population of western Waigeo and increasing tourism in this area (both national and international) demand more gardens, infrastructure and tourism resorts. Waigeo got a regency capital of Raja Ampat administrative province of Indonesia some years ago which resulted in boosting development, investments into Waisai, the new regency capital and in provincial airport. Waigeo is initially rich in limestone rocks and limestone is widely used for roads and buildings construction. Growing population (partly a result of immigration from other islands of Indonesia) requires more firewood and charcoal. An illegal logging is

rare but is a reality. Aforementioned factors result in decline of primary lowland rainforests especially in south-western part of Waigeo and this trend is observed, projected and likely to continue. No direct effect of aforementioned threats was observed on the population of *P. megalostoma* sp. nov. On the other hand, *P. megalostoma* sp. nov. was not found in disturbed forests. Between 2001-2014 south-western Waigeo lost just about 1100 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), but not exactly in the area where *P. megalostoma* sp. nov. occurs. Additional research is required on Waigeo to clarify distribution of this species, calculate population size and highlight threats.

***Palaina* (s. l.) *mengen* sp. nov.** (Fig. 71, plate 40
figs 17-23, map 29)

<http://zoobank.org/A17B5493-F4C9-4B22-A804-FBE1B6C3A959>

Holotype UF (No 508074): UF 366601 Mollusca, Diplommatinidae 15 specimen(s) *Palaina* [printed] sp. 9 [handwritten] Papua New Guinea, East New Britain Province New Britain, 12 km N Marmar Village along trail to Pakia Village secondary hill forest 900 meters 5.43187° S 151.45971° E Slapcinsky, J. 25-February-2005 JS-0772 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 772 [handwritten] / Mollusca 366601 [printed].

Paratypes 18 specimens: 9 adults, 2 subadults & 2 juv. UF, 1 adult KGC: same labels as holotype [two adults are badly broken]; 4 adults UF: UF 366603 Mollusca Diplommatinidae 4 specimen(s) *Palaina* Papua New Guinea, East New Britain Province New Britain, Saukale, 13 km NW Marmar Village along trail to Pakia Village primary hill forest 850 meters 5.42551° S 151.45337° E Slapcinsky, J. 2/28/2005 JS-0775 drowned in water > 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 775 [handwritten] [one adult is badly broken].

Derivatio nominis: This species is named after Mengen, local tribe and language of New Britain, where this species was first found. Noun in apposition, invariable.

Measurements: Holotype H = 2.4 mm, D = 1.5 mm, HW = 1.45 mm, PD = 1.2 mm. Selected paratype specimens: H = 2.5 mm, D = 1.5 mm, HW = 1.3 mm, PD = 1.1 mm; H = 2.45 mm, D = 1.4 mm, HW = 1.4 mm, PD = 1.2 mm; H = 2.4 mm, D = 1.5 mm, HW = 1.35 mm, PD = 1.2 mm; H = 2.4 mm, D = 0.95 mm, HW = 1.4 mm, PD = 1.05 mm.

Description: Shell is small, yellowish, sinistral, broadly conical with conical apex. Shell with 5¼ convex whorls, the 1½ embryonic whorl is microscopically pitted (pits are partly arranged in axial rows). The suture is moderately deeply impressed.



The ultimate whorl is constricted, as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short shallow impression, a short zone of denser and stronger sinuous axial ribs and deeply impressed suture above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense, partly straight partly sinuous ribs. The ribs becoming coarser (higher) and more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern except at the area of constriction (see above). The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 10-12 ribs per 1 mm. Spiral striae are very delicate and dense. The aperture is not tilted against the coiling axis, is circular or oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal side of the peristome is attached to the ultimate whorl. The peristome is double, thin in lateral view. The inner peristome forms a continuous polished callus. The palatal margins of both peristomes are sinuous. The inner peristome with two obtuse protrudings - near the parietal / palatal and the columellar / parietal junctions. The columella is broad and smooth with glass-like semitransparent callus all along its inner margin. The operculum is derivative - circular or ovoid, transparent, with slightly indicated concentric lines and broad, short and flat spatula-like median "handler" on the inner surface.

Differential diagnosis: This species is conchologically similar to *Palaina commixta* I. Rensch, 1937 (New Britain Island), but differs in lower and broader shell, presence of a median knob along inner margin of the columella (the columella is twisted in basal fourth in *P. commixta*), the axial ribs not being bent counter-clockwise (see description of *P. commixta* above for further details), and the inner peristome provided with two protrudings (protrudings are absent in *P. commixta*).

Ecology: Primary and secondary lower montane rainforests, sampled at altitudes 850-900 m.

Distribution: Bismarck Archipelago: New Britain Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The current AOO is 8 km², but the maximum AOO is likely much higher. The population size and trend are unknown. Since this species also reported from secondary rainforests, threats for this species cannot be identified without additional basic studies.

***Palaina* (s. l.) *minuscularia* sp. nov.** (Figs 72, 127-128, plate 41 figs 1-9, map 16)

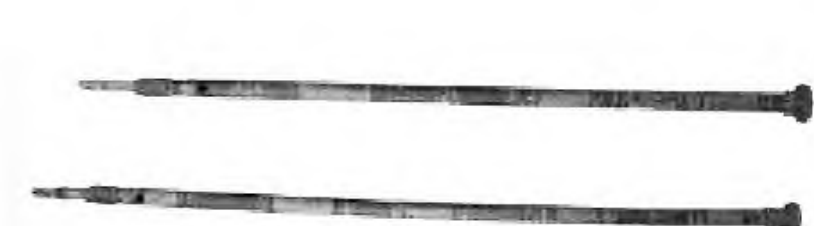
<http://zoobank.org/640EC68D-FA1F-433F-A70B-F4BDCF0DCE6B>

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov. Paratypes 8 specimens: 3 adults KGC & 1 adult NME: same label as holotype; 1 adult KGC & 1 adult NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 70-350 m, 04-06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov; 33 adults KGC & 10 adults NME: INDONESIA E, Raja Ampat, Misool Island S, Lilinta (Lelintah) vill. env., 02°02'57,43"S, 130°15'58,11"E, 16 m, 02.II.2012, secondary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: This species is named from Latin 'minuscularius' [small, smallest], because of the extraordinary small shell.

Measurements: Holotype H = 1.3 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.55 mm. Selected paratype specimens from locus typicus: H = 1.4 mm, D = 0.8 mm, HW = 0.8 mm, PD = 0.55 mm; H = 1.35 mm, D = 0.75 mm, HW = 0.8 mm, PD = 0.5 mm. Selected paratype specimens from Lilinta vill. env.: H = 1.8 mm, D = 0.9 mm, HW = 0.8 mm, PD = 0.6 mm; H = 1.7 mm, D = 1 mm, HW = 0.8 mm, PD = 0.7 mm; H = 1.6 mm, D = 0.9 mm, HW = 0.9 mm, PD = 0.7 mm.

Description: Shell is very small, white, sinistral, cylindrical with flattened apex. Shell with 5¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is slightly constricted, nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by weak sutural impression above it. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate and dense straight or slightly sinuous axial ribs. The ribs becoming coarser and more distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 25-28 ribs per 0.5 mm. Spiral striae are distinct, very delicate and rather widely-spaced (4 rows of spiral striae per 30 µm measured on the ultimate whorl above the aperture). The aperture is not or slightly tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penul-



ultimate whorl in apertural view. The peristome is distinctly double. There are 2 strong lamellae between the inner and the outer peristomes in fully grown specimens. The parietal margin of the peristome is attached to the ultimate whorl. Peristomal margins are not sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columella is thin and glass-like semitransparent, provided with a small basal knob. The operculum is derivative - circular, in a form of a flying disc with slightly raised margin and without ridges.

Differential diagnosis: This species is similar to several minute Papuan *Palaina*. Specific characters are discussed in table 15.

Ecology: This species occurs in primary and old-growth secondary lowland rainforests. Specimens observed in wet leaf litter accumulated in cavities at limestone formations as well as on the under-

sides of fallen leaves.

Distribution: Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. The current EOO is about 12 km². The maximum EOO estimated less than 2000 km² taking into account the area of Misool Island and available habitat. The current AOO is 8 km². The maximum AOO estimated much higher but definitively below 500 km². The population size and trend are unknown. Generally, *Palaina minuscularia* sp. nov. is not uncommon. This species is currently known from two localities and inhabits both primary and old-growth secondary lowland rainforests on limestone soils. No major threats to this species have been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. Further research is required on distribution of this species as well as on population size and threats.

Table 15. Papuan species of *Palaina* s. l. similar to *P. minuscularia* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. minuscularia</i> sp. nov.
<i>Palaina flavocylindrica</i> sp. nov.	spiral striae are lacking at 80x magnification (but is very delicate and dense at 300x magnification), the columella simple, several lamellae between the inner and the outer peristomes	spiral striae are distinct at 80x magnification, the columella with basal knob, 2 rather strong lamellae between the inner and the outer peristomes
<i>P. iha</i> sp. nov.	axial ribs are rather high and coarse, about 14-16 ribs per 0.5 mm, columella simple, 8-9 rows of spiral striae per 30 µm (measured above the aperture), few inconspicuous flat lamellae between the inner and the outer peristomes, the outer peristome is stronger than the inner one	axial ribs are delicate and rather low, about 25-28 ribs per 0.5 mm, columella with knob, 4 rows of spiral striae per 30 µm (measured above the aperture), 2 rather strong lamellae between the inner and the outer peristomes, the outer peristome is not conspicuously stronger than the inner one
<i>P. insulana</i> sp. nov.	the columella is simple, H = 1.8-1.95 mm, 7-8 rows of spiral striae per 30 µm (measured above the aperture), with several lamellae between the inner and the outer peristomes	the columella with basal knob, H = 1.3-1.6 mm, 4 rows of spiral striae per 30 µm (measured above the aperture), 2 rather strong lamellae between the inner and the outer peristomes
<i>P. waigeo</i> sp. nov.	the columella is simple, 5-6 rows of spiral striae per 30 µm (measured above the aperture), few inconspicuous flat lamellae between the inner and the outer peristomes, the outer peristome is stronger than the inner one	the columella with basal knob, 4 rows of spiral striae per 30 µm (measured above the aperture), 2 rather strong lamellae between the inner and the outer peristomes, the outer peristome is not conspicuously stronger than the inner one

***Palaina* (s. l.) *minutula* sp. nov.** (Plate 40 figs 24-26, map 6)
<http://zoobank.org/699275D3-1F89-4D1D-8091-EB5D8D61EB96>
Holotype NME: INDONESIA E, North Moluccas, Halmahera N, Galela area, Mt. Ngededo Ma Girapang at Roko vill., 1°50'07"N, 127°43'17"E, 230 m, 02.VII.2013, primary & secondary lowland rainforest, leaf litter, leg. K.Greke.

Derivatio nominis: Named from Latin “minutulus” [tiny, very small], because of minute size of the shell.

Measurements: Holotype H = 1.35 mm, D = 0.85 mm, HW = 0.8 mm, PD = 0.6 mm.

Description: Shell is very small, creamy to pale brown, dextral, cylindrical with flattened apex. Shell with 5 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply im-



pressed. The ultimate whorl is slightly constricted, slightly wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is not delimited on shell wall. The teleoconch is sculptured with coarse widely-spaced straight axial ribs. The ribs becoming 4x more distant on the last half whorl. The ribs are straight to the coiling axis. There are 9-10 ribs per 0.5 mm. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is shifted right against the coiling axis in apertural view. The peristome is distinctly double, without lamellae between the inner and the outer peristome. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. The inner peristome forms a continuous polished callus. Peristomal margins are not sinuous. Because only one specimen was available for study, I did not damage the shell to observe the internal lamellae which remains unknown for this species. Operculum is unknown.

Differential diagnosis: Very distinctive species among all congeners due to the combination of the following characters: shell very small, axial ribbing pattern very widely-spaced, the peristome strong and distinctly double.

Ecology: The only known specimen was sampled from leaf litter in primary lowland rainforest on a limestone hill where small-scale selective logging was ongoing. This locality is now selectively logged.

Distribution: North Moluccas: Northern arm of Halmahera Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO estimated under 20000 km² taking into account its possible distribution on Halmahera as well as on Bacan. The maximum EOO is estimated about 5000 km². The current AOO is 4 km², the maximum AOO is possibly significantly larger but estimated less than 500 km². The population size and trend are unknown. Habitat loss and alteration caused by logging, mining, and conversion of forests into gardens and plantations, as well as expansion of human settlements in lowland areas are main threats. However, the impact on *P. minutula* sp. nov. population is not yet documented. The forested part of the maximum EOO is decreasing constantly, between 2001 and 2014 over 87000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Continuing decline in extent and quality of habitat is observed and projected, especially considering constantly growing human popu-

lation of North Moluccas. Further basic research on population size, trend, ecological preferences and threats for *P. minutula* sp. nov. is essential.

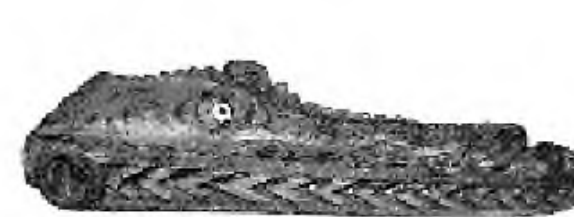
***Palaina* (s. l.) *mirifica* sp. nov.** (Figs 73-74, plate 41
figs 10-22, map 15)

<http://zoobank.org/9601DA83-E9FB-483E-8CA0-0B46ECF394D9>

Holotype NMNL: Coll. J.J. Vermeulen, nr. 4728 *Palaina* indet. - Diplommatinidae 1995.06. INDONESIA. Tanimbar Islands; W part Yamdena Isl., near Kpg. Makatian. Undisturbed primary forest on limestone, near riverbed, 4-6 km from the sea (3-5 km from a brackish river). Leg. A.J. Whitten, 00/10/1995.

Paratypes: 16 adults NMNL: 9 same label as holotype; 7 adults NMNL: Coll. J.J. Vermeulen, nr. 4727 *Palaina* indet. - Diplommatinidae 1995.06. INDONESIA. Tanimbar Islands; W part Yamdena Isl., near Kpg. Makatian. Undisturbed primary forest on limestone, near riverbed, 4-6 km from the sea (3-5 km from a brackish river). Leg. A.J. Whitten, 00/10/1995 [one adult is broken]; 2 adults LKCNHM: ZRC.1999.2451 [handwritten] / Coll. J.J. Vermeulen, nr. 4728 *Arinia* - [printed] ZRC.199.2451 [handwritten] Diplommatinidae [printed] 2nos [handwritten] INDONESIA, Tanimbar Group, W part Yamdena Isl., nr Kpg Makatian. Undisturbed primary fst on limestone, nr riverbed, 100-150 m asl, 4-6 km from the sea (3-5 km from a brackish river. Leg. A.J. Whitten, 10/1995. [printed] / ZOOLOGICAL REFERENCE COLLECTION DEPARTMENT OF ZOOLOGY NATIONAL UNIVERSITY OF SINGAPORE [printed] Diplommatinidae ZRC.MOL.10459 Ex [handwritten] ZRC. [printed] 199.2451 [handwritten] No. Spec. [printed] 2 nos. [handwritten] Species. [printed] *Arinia* [handwritten] Locality [printed] Indonesia, Tanimbar Group, W. part Yamdena Island, nr. Kampong Makatian. [handwritten] Collector [printed] A.J. Whitten Date [printed] Oct. 1995 [handwritten] Det. by [printed] JJ Vermeulen, nr. 4728 [handwritten] Date [printed]; 2 adults LKCNHM: LKCNHM: ZRC.1999.2450 [handwritten] / Coll. J.J. Vermeulen, nr. 4727 *Arinia* - [printed] ZRC.199.2449 [handwritten] Diplommatinidae [printed] 2nos [handwritten] INDONESIA, Tanimbar Group, W part Yamdena Isl., nr Kpg Makatian. Undisturbed primary fst on limestone, nr riverbed, 100-150 m asl, 4-6 km from the sea (3-5 km from a brackish river. Leg. A.J. Whitten, 10/1995. [printed] / ZOOLOGICAL REFERENCE COLLECTION DEPARTMENT OF ZOOLOGY NATIONAL UNIVERSITY OF SINGAPORE [printed] Diplommatinidae ZRC.MOL.10458 Ex [handwritten] ZRC. [printed] 199.2450 [handwritten] No. Spec. [printed] 2 nos. [handwritten] Species. [printed] *Arinia* [handwritten] Locality [printed] Indonesia, Tanimbar Group, W. part Yamdena Island, nr. Kampong Makatian. [handwritten] Collector [printed] A.J. Whitten Date [printed] Oct. 1995 [handwritten] Det. by [printed] JJ Vermeulen, nr. 4727 [handwritten] Date [printed].

Derivatio nominis: This species is named from



Latin 'mirificus' [extraordinary, wonder, marvelous], because of extraordinary expanded margins of the outer peristome.

Measurements: Holotype H = 2.8 mm, D = 2 mm, HW = 1.7 mm, PD = 1.85 mm (1 mm without expanding margin of the outer peristome). Selected paratypic specimens: H = 3.3 mm, D = 2.5 mm, HW = 1.9 mm, PD = 2.15 mm (1.2 mm without expanding margin of the outer peristome); H = 3.05 mm, D = 2.3 mm, HW = 1.8 mm, PD = 1.9 mm (1.2 mm without expanding margin of the outer peristome); H = 3 mm, D = 2.3 mm, HW = 1.7 mm, PD = 1.8 mm (1.1 mm without expanding margin of the outer peristome).

Description: Shell is large, whitish to creamy coloured, sinistral, obese, with conical apex. Shell with 5½ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is slightly constricted, ascending, it is slightly narrower than or as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly delimited by presence of a broad and very shallow impression and a zone of dense delicate axial ribs. A cavity-like impression present on the suture just above the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate very widely-spaced and quite high straight ribs. There are abrupt changes in the ribbing pattern - early whorls and the constriction area are covered by much denser axial ribs. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 4-6 ribs per 1 mm. The ribs becoming more widely-spaced on the last half whorl. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular or oval and has entire apertural rim. In apertural view the position of the aperture is more or less central below the coiling axis or aperture shifted left. The peristome is double. The parietal margin of the peristome completely attached to the ultimate whorl. The inner peristome forms a narrow continuous polished callus. The outer peristome is more or less broadly discontinued parietally. The outer peristome expands very strongly, wing-like on the palatal, basal and columellar margins beyond the inner peristome. In several specimens this expansion overrunning over the entire penultimate whorl in apertural view (Plate 141 figs 10-14, 15 & 19) and is straight or reflexed. The palatal and the columellar margins of the outer peristome are sinuous. The columella is simple, obliquely twisted and provided with an obtuse horizontal columellaris in

its basal third. The operculum is derivative - circular, with several layers of concentric ridges on the outer surface.

Differential diagnosis: This species is peculiar among all congeners primarily due to the extremely widely-spaced axial ribs and very strong expansion of the outer peristome. It differs from its sympatric congener *Palaina tanimbarensis* sp. nov. (see description of this species below) in axial ribs being straight low and not folded (ribs are folded and lamella-like high in *P. tanimbarensis* sp. nov.), more obese shell (shell is cylindrical in *P. tanimbarensis* sp. nov.) and much stronger expanding outer peristome.

Ecology: Specimens found in primary riverine lowland rainforest on limestone soil.

Distribution: Tanimbar Islands: Yamdena Island. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO estimated about 9900 km² taking into account the area of Tanimbar Islands. It is very unlikely *Palaina mirifica* sp. nov. is distributed all over Tanimbar Islands. The current AOO is 4 km², the maximum AOO estimated much less than 500 km² taking into account available habitat. This species is known from single locality. The population size, trend and threats are unknown. Few untouched rainforest patches remains on Yamdena Island nowadays.

***Palaina* (s. l.) *misoolensis* sp. nov.** (Figs 75-76, plate 41 figs 23-30, map 17)

<http://zoobank.org/DA95F581-452C-4300-91E9-40C0C26E4898>

Holotype NME: INDONESIA E, Raja Ampat, Misool Island S, Biga vill. ~7,5 km W, River Biga valley, 02°01'23"S, 130°12'38"E, 45-78 m, 03.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 17 specimens: 5 adults & 2 juv. NME, 10 adults KGC: same label as holotype.

Derivatio nominis: Toponymic. This species is named after Misool Island, its area of origin.

Measurements: Holotype H = 3.2 mm, D = 2.05 mm, HW = 1.75 mm, PD = 1.6 mm. Selected paratypic specimens: H = 3.2 mm, D = 2.1 mm, HW = 1.7 mm, PD = 1.5 mm; H = 3.2 mm, D = 1.95 mm, HW = 1.8 mm, PD = 1.55 mm.

Description: Shell is large, pale yellow, yellow or pink, sinistral, broadly fusiform with conical apex. Shell with 6 rather convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The penultimate whorl is somewhat bulbous. The ultimate whorl strongly con-



stricted, is narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by presence of a short and shallow impression and a cavity-like impressed suture just above the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with moderately coarse, dense, straight ribs. The ribs becoming coarser and more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 11-12 ribs per 1 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular to semicircular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal side of the peristome is pressed against the parietal wall and is completely attached to the ultimate whorl. The peristome is double. The inner peristome forms a continuous polished callus. The margins of the inner peristome are not sinuous. The outer peristome is broadly discontinued parietally, expands strongly beyond the inner one. All margins of the outer peristome are sinuous. Four small obtuse protrudings - two basal, one palatal and one columellar - presented on the outer peristome (Plate 41 figs 23, 25-26). The columella is smooth, provided with a median knob which is directed forwards. Therefore an inconspicuous flat columellaris is visible in the aperture in lateral view. The operculum is derivative - circular, with Γ -like median protruding ("handler") on the inner surface, without concentric lines.

Differential diagnosis: This species is conchologically very similar to *P. bicornis* van Benthem Jutting, 1958a and *P. quadricornis* van Benthem Jutting, 1958a (both from Misool Island) but has columellar denticle visible in the aperture (in lateral view). Another very similar species, *P. onin* sp. nov. (Onin Peninsula; see description of this species below) has simple columella.

Ecology: Specimens were sampled from the undersides of fallen leaves in primary lowland rainforest at base of limestone rocks in a wet and shady place.

Distribution: Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. Not enough data available to calculate current EOO. The maximum EOO estimated below 2000 km² taking into account the area of Misool and available habitat. The current AOO is 4 km². The maximum AOO estimated much higher but below 500 km². The population size and trend are unknown.

Palaina misoolensis sp. nov. is locally common in riverine forests in upper course of Biga river. This species is currently known from single locality and inhabits old-growth lowland rainforests on limestone and clayish soils. No major threats to this species have been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. Further research is required on distribution of this species as well as on population size, trend and threats.

***Palaina* (s. l.) *mutis* sp. nov.** (Fig. 77, plate 41 figs 31-34, map 14)

<http://zoobank.org/B5DDAC20-4DBD-48CF-B700-B3F40E1AA8EA>

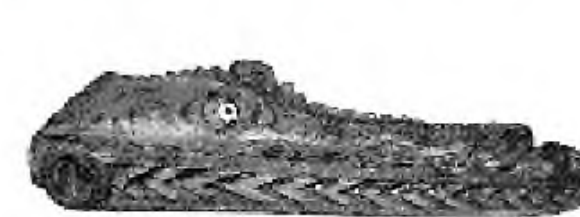
Holotype NME: INDONESIA E, Timor W, Fatumnasi vill. 3 km NNE, 9°37'28"S, 124°14'19"E, 1620-1630 m, 05.IV.2016, base of limestone outcrop, leaf litter, leg. L.Wagner.

Paratypes 91 specimens: 15 adults & 6 juv. NME, 48 adults, 5 subadults & 17 juv. KGC: same label as holotype; 1 adult KGC: INDONESIA, Timor Island, Fatumnasi env., semidry forest, 30.III.2012, leg. L.Wagner.

Derivatio nominis: Toponymic. This species is named after Mount Mutis, the highest peak of East Nusa Tenggara (about 2427 m) where this species occurs. Noun in apposition, invariable.

Measurements: Holotype H = 4.1 mm, D = 2.25 mm, HW = 2.3 mm, PD = 1.6 mm. Selected paratype specimens: H = 4 mm, D = 2.2 mm, HW = 2.2 mm, PD = 1.5 mm; H = 4 mm, D = 2 mm, HW = 2.1 mm, PD = 1.3 mm; H = 3.9 mm, D = 2.15 mm, HW = 2.1 mm, PD = 1.4 mm; H = 3.9 mm, D = 2.2 mm, HW = 2 mm, PD = 1.4 mm; H = 3.7 mm, D = 2.1 mm, HW = 2 mm, PD = 1.3 mm.

Description: Shell is large, yellow to pale brown but white in juvenile and subadult specimens, sinistral, high cylindrical with conical apex. Shell with 6¼ convex whorls, the 1½ embryonic whorl is microscopically striate and pitted. The suture is deeply impressed. The ultimate whorl is slightly constricted and slightly descending, it is about as wide as the penultimate whorl in apertural view. The umbilicus is open, narrow and perspective. The constriction is poorly defined by a short shallow impression supplemented with a zone of somewhat denser axial ribs. A weak bulb present just beyond the constriction above the columellar side of the aperture. There is a flat cavity-like impression on the suture just above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense slightly sinuous axial ribs. The ribs becoming coarser but not much sparser on the last half whorl. There are



no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 12-15 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis, is oval and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is double. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a broad continuous polished callus. The outer peristome is narrowly discontinued parietally. The palatal margins of both peristomes are slightly sinuous. The columella is smooth, broad. The operculum is derivative, circular with concentric ridges on outer side.

Differential diagnosis: This species is very distinctive among all congeners due to the combination of the following characters: shell high cylindrical, the ultimate whorl descending and building open and perspective umbilicus.

Ecology: Specimens were sampled from thick layer of leaf litter and decaying wood accumulated at base of limestone rock outcrops in moist lower montane eucalypt forest.

Distribution: Lesser Sunda Islands: western part of Timor Island.

Conservation status: Near Threatened, NT. Not enough data available to calculate current EOO. The maximum EOO for this species is definitively less than 5500 km² taking into account available habitat in western part of Timor. The maximum EOO estimated below 5500 km². The current AOO is 12 km², the maximum AOO is significantly larger but estimated below 500 km². The population size and trend are unknown. This species is common on Mt. Mutis on certain places with limestone outcrops. Mt. Mutis is protected area with rangers and logging is not a real threat for this area. However, grazing (cows and horses) is ongoing at lower altitudes in eucalypt forest where *P. mutis* sp. nov. occurs. Livestock is not climbing the limestone outcrops. Relic patches of rainforest in this generally arid region can also get affected by more frequent and longer dry periods caused by global warming and El Niño weather patterns. Continuing decline in extent and quality of habitat is therefore projected for the future but with a little effect within next 10 years. Presently, one location is known for this species. Further basic research is required.

***Palaina* (s. l.) *novoguineensis* E.A. Smith, 1897**
(Fig. 64, plate 42 figs 1-13, map 26)

Lectotype BMNH [herewith designated]: ~~sulphurea~~ [original correction] Smith (MS) Kapaur New Guinea

= *dohertyi* Smith [handwritten] / *Palaina sulphurea* [original correction] *dohertyi* Smith Kapaur New Guinea Types. (D....) 1897.7.30.59-60 [handwritten, partly unreadable].

Paralectotype 1 adult BMNH [herewith designated]: same labels as lectotype.

Additional material: 1 adult KGC: INDONESIA E, West Papua, S Bird's Neck, Kaimana 7-9 km NW, 3°35'02"S, 133°42'58"E, 25-200 m, 05.IX.2010, primary lowland rainforest on limestone, leg. K.Greke; 1 adult KGC: INDONESIA E, West Papua, Onin Peninsula, Fak-Fak 5-7 km N, 2°53'26"S, 132°18'22"E, 300-400 m, 23.IX.2010, primary lowland rainforest on limestone, leg. D.Telnov; 1 adult KGC & 1 adult NME: INDONESIA E, West PAPUA, Onin Peninsula, Fak-Fak 10 km E, 2°56'32"S, 132°23'01"E, Sakarteman vill. 1-4 km W, River Sakarteman valley, 350-450 m, 26.IX.2010, primary lowland rainforest on limestone, leg. K.Greke; 9 adults KGC, 3 adults, 2 subadults & 4 juv. NME: INDONESIA E, Raja Ampat, Misool Island S, Lilinta (Lelintah) vill. env., 02°02'57,43"S, 130°15'58,11"E, 16 m, 02.II.2012, secondary lowland rainforest on limestone, leg. D.Telnov.

Note: There are confusions with labelling of the types of this species. Originally, these were labelled as '*Palaina sulphurea* Smith (MS)', later this was corrected to '*dohertyi*', but 24.9.1962 note from van Benthem Jutting reads 'These two shells are *Palaina novoguineensis* Smith 1897'. I herewith reconfirm that according to the original description, two shells of '1897.7.30.59-60' belong to *Palaina novoguineensis* but the figures in the original descriptions of both *P. dohertyi* and *P. novoguineensis* were reversed.

Lectotype designation: Lectotype is selected from two syntypes with identical labels.

References: Smith E.A. (1897: 419, pl. 9 figs 30-31 not 32-33); Kobelt & von Möllendorff (1898: 132), checklist, as *Palaina* Subgen. *Eupalaina* Kob. et. Mlldff. *novo-guineensis*; Kobelt (1902: 402), as *Palaina* (*Palaina*) *novoguineensis*; van Benthem Jutting (1963: 703).

Measurements: Lectotype H = 3.7 mm, D = 2.3 mm, HW = 2 mm, PD = 1.8 mm. Specimen from Kaimana env.: H = 4.2 mm, D = 2.7 mm, HW = 2.2 mm, PD = 2 mm. Specimens from River Sakarteman valley: H = 4.1 mm, D = 2.5 mm, HW = 2 mm, PD = 1.9 mm; H = 4.05 mm, D = 2.6 mm, HW = 2.1 mm, PD = 2 mm.

Description: Shell is small, yellowish to pale brown, dextral, obese with conical apex. Shell with 6¼ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The penultimate whorl is slightly bulbous in certain specimens. The ultimate whorl is



constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a deep and broad impression and a zone of dense axial ribs. The constriction is more or less centered in apertural view. A strong bulb is present just beyond the constriction above the columellar side of the aperture (Plate 42 fig. 13). The teleoconch is sculptured with coarse dense sinuous ribs. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 10-13 ribs per 1 mm. The ribs becoming slightly more distant on the last half whorl. Spiral striae are delicate dense and wavy. The aperture is not tilted to the coiling axis and is circular in type specimens but oval in recent material, apertural rim is entire. The aperture is more or less centered below the penultimate whorl or is slightly shifted right in apertural view. The parietal side of the peristome is pressed against the parietal wall and is completely attached to the ultimate whorl. The peristome is double, consists of numerous dense lamellae in lateral view. The inner peristome forms a continuous polished callus. In specimens from Sakarteman river valley and Kaimana env. the peristome is somewhat expanding parietally and covering over a half of the ultimate whorl in apertural view. The palatal and the basal margins of both peristomes are sinuous. The columella is smooth, glass-like semi-transparent, slightly angulate medially (in Kaimana specimen columella is straight and not angulate). In certain specimens columellaris is visible in the aperture as a flat callus. The operculum is derivative - circular with several concentric ridges on the outer surface.

Ecology: This species occurs in primary lowland rainforests at altitudes up to 450 m.

Distribution: New Guinea: Onin Peninsula and Bird's Neck Isthmus. Raja Ampat Islands: Misool Island.

Conservation status: Least Concern, LC. The current EOO is about 615 km². The maximum EOO for this species estimated about 65000 km². The current AOO is 12 km², the maximum AOO estimated over 2000 km² taking into account available habitat. The population size and trend are unknown. Habitat loss and alteration are the main threats. There are three locations. On Onin Peninsula, mostly coastal areas of rainforest are in decline due to the expansion of settlements and building construction activities, while on Bomberai Peninsula lowland areas are intensively logged and converted to gardens. The forested part of the max-

imum EOO is decreasing constantly. On Bomberai Peninsula between 2001 and 2014 over 28000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Continuing decline in extent and quality of habitat is observed and projected taking into account constantly growing human population in the area. However, most of Onin Peninsula, Bird's Neck Isthmus and Misool Island remain intact with vast amount of undisturbed habitat available. I can't project any significant habitat decline for the next 10 years. Additional research is required on distribution, population size, as well as on threats for this species.

***Palaina* (s. l.) *novopommerana* I. et B. Rensch, 1929** (Fig. 78, plate 42 figs 14-25, map 29)

= *Palaina vexator* I. et B. Rensch, 1929 **syn.**

nov. (Plate 42 figs 10-20, 25)

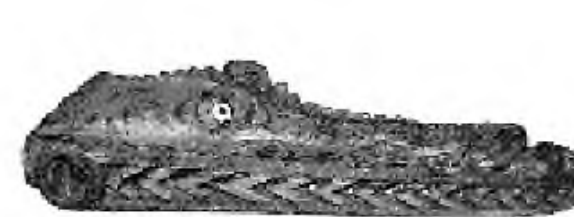
Syntypes *P. novopommerana*: 5 adults MHUB: Zoolog. Museum Berlin [printed] 90932 *Palaina novopommerana* I.+B.Rensch * Neu-Pommern Weite Bucht Karlei Ig. P. Schneider [handwritten] / Zoolog. Museum Berlin. Typus von: [printed, original correction by hand] *Palaina novopommerana* I. + B.Rensch Zool. Anz. 80, 1929, p. 84, Abb. 4 [handwritten] [label red]; 4 adults FMNH: 123700 [printed] / 123700 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 4 dry spec. Possible Syntype(s): *Palaina novopommerana* I. Rensch & B. Rensch, 1929 Sta. JS-123700, Papua New Guinea, Bismarck Archipelago, New-Pommern (= New Britain), Karlei, Malkong Pater J. Schneider! ex W. J. Eyerdam ex Zoologisches Museum Berlin (Acc.# 12584) [printed].

Syntypes *P. vexator* 4 adults MHUB: Zoolog. Museum Berlin [printed] 90938 *Palaina vexator* I.+B.Rensch * Neu-Pommern Weite Bucht Ig. P. Schneider [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina vexator* I. + B.Rensch Zool. Anz. 80, 1929, p. 85, Abb. 5 [handwritten] [label red].

Additional material 1 adult UF: UF 366584 Mollusca, Diplommatinidae 1 specimen(s) *Palaina* Papua New Guinea, East New Britain Province New Britain, 4 km NW Marmar Village along trail to Pakia Village secondary hill forest 450 meters 5.49651° S 151.49027° E Slapcinsky, J. 04-March-2005 JS-0777 drowned in water > 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY / 777.

Note: In original description of *P. novopommerana* it is stated "Material. 26 Exemplare..." (p. 84), but later "Typus. 5 Exemplare im Zoologischen Museum, Berlin..." (p. 85). Since the total number of syntypes is not clear, lectotype designation is not made (figured specimen cannot be allocated among syntypes).

References *P. novopommerana*: Rensch I. & B. (1929: 84); Rensch I. (1937: 602).



References *P. vexator*: Rensch I. & B. (1929: 85); Rensch I. (1937: 603).

Measurements: Selected syntypes *P. novopomerana* H = 5.1 mm, D = 2.8 mm, HW = 2.7 mm, PD = 2 mm; H = 5.3 mm, D = 2.9 mm; H = 5 mm, D = 2.9 mm; H = 4.9 mm, D = 3 mm; H = 4.7 mm, D = 2.8 mm. Selected syntypes *P. vexator* H = 4.1 mm, D = 2.4 mm, HW = 2.2 mm, PD = 1.7 mm; H = 4.1 mm, D = 2.4 mm; HW = 4.1 mm, PD = 2.2 mm; H = 3.7 mm, D = 2.05 mm. Specimen from Marmar vill. env. H = 4.4 mm.

Description: Shell is very large, white, yellowish or pale brown, sinistral, high conical with conical apex. Shell with $6\frac{1}{4}$ - $6\frac{1}{2}$ convex whorls, the $1\frac{1}{2}$ - $1\frac{3}{4}$ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult (umbilical crack mentioned by I. Rensch 1937 is a variable character). The constriction is poorly defined by presence of a shallow impression and a zone of stronger sinuous axial ribs. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with comparatively fine dense sinuous axial ribs. The ribs are variable: more or less equally spaced throughout the teleoconch and more widely-spaced on the early whorls. The ribs becoming stronger and more widely-spaced on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls. The ribs range from straight to oblique to the coiling axis. There are 8-12 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. In apertural view the position of the aperture is more or less central below the coiling axis or is slightly shifted left. The peristome is double, consists of several dense lamellae in lateral view. The parietal margin of the peristome is completely attached to the ultimate whorl. The inner peristome forms a broad continuous polished callus. The palatal margins of both peristomes are slightly sinuous. In certain specimens the outer peristome expands strongly beyond the inner one. The columella is broad and smooth, provided with obliquely twisted horizontal columellaris in its basal fourth. The columellaris is directed outwards but is not visible in the aperture. The operculum is derivative - circular and transparent, in a form of a flying disc (impressed on the outer surface), without concentric lines.

Ecology: This species occurs in secondary lowland rainforests. New Britain Island was initially covered

by primary lowland to mid montane rainforests.

Distribution: Bismarck Archipelago: New Britain. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO for this species estimated 145000 km² taking into account the area of New Britain, New Ireland and adjacent islets. The current AOO is 4 km². The maximum AOO is likely significantly higher, but definitively below the threshold of 500 km². The population size and trend are unknown, but Rensch I. (1937) stated this species was found in large quantities. Threats for this species are unknown. Further research is required to uncover present distribution, evaluate population size and highlight threats.

***Palaina* (s. l.) *obiensis* sp. nov.** (Figs 79, 138-139, plate 43 figs 1-5, map 6)

<http://zoobank.org/AADA0676-CFDD-4F61-9DC1-1B83463F2DEB>

Holotype NME: INDONESIA E, North Moluccas, Obi Islands, Obira Is., S part, Wayaloar vill. NE ~4 km, $1^{\circ}41'01''$ S, $127^{\circ}36'13''$ E, 16.XII.2013, primary and disturbed rainforest, leg. L.Wagner.

Paratypes 42 specimens: 1 subadult KGC: same label as holotype; 15 adults, 1 subadult & 7 juv. UF: UF 426419 Mollusca, Diplommatinidae 22-spec. *Palaina* sp. 13 Indonesia, Maluku Utara Province Obi Island, border of garden and rainforest 2.3 km N of Woi gardens and rainforest 150 meters -1.7045° 127.6067° John Slapcinsky 26 Oct 2008, JDS-0942 dry FLORIDA MUSEUM OF NATURAL HISTORY [some of paratypes are badly broken]; 14 adults & 1 juv. UF, 3 adult KGC: UF 426284 Mollusca, Diplommatinidae 17-spec. *Palaina* Indonesia, Maluku Utara Province Obi Island, border of garden and rainforest 2.3 km N of Woi gardens and rainforest 150 meters -1.7045° 127.6067° John Slapcinsky 26 Oct 2008, JDS-0942 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY.

Derivatio nominis: Toponymic. This species is named after Obi Islands, its area of origin.

Measurements: Holotype H = 2.1 mm, D = 1.3 mm, HW = 1.3 mm, PD = 0.9 mm. Paratype from locus typicus: H = 2.1 mm, D = 1.3 mm, HW = 1.15 mm, PD = 0.75 mm. Selected paratypic specimens from Woi vill. env.: H = 2.3 mm, D = 1.4 mm, HW = 1.3 mm, PD = 0.95 mm; H = 2.3 mm, D = 1.4 mm, HW = 1.3 mm, PD = 0.9 mm; H = 2.2 mm, D = 1.3 mm, HW = 1.25 mm, PD = 0.9 mm.

Description: Shell is small, pale brown or white, sinistral, cylindrical with conical apex. Shell with 6 convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The um-



umbilicus is closed in adult. The constriction is well defined by presence of a short shallow impression, denser pattern and height reduction in axial ribs and suture deeply impressed above the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with lamella-like and widely-spaced straight ribs. The ribs becoming much stronger, higher and somewhat more widely-spaced on the last half whorl. There are abrupt changes in the ribbing pattern at the constriction area (see above). The ribs are partially synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 4-5 ribs per 0.5 mm but about 10-12 ribs per 0.5 mm at the constriction. Spiral striae are lacking at 300x magnification on younger whorls. On older teleoconch whorls a very delicate spiral striae are present at 300x magnification (4-5 rows of spiral striae per 30 μ m). The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a narrow continuous polished callus. The outer peristome is broadly discontinued parietally. The palatal margin of the outer peristome is somewhat sinuous. In fully grown specimens the area of the parietal / palatal junction of the outer peristome expands into an obtuse protruding. The columella is smooth, slightly twisted medially and provided with a flat glass-like semitransparent basal knob. The operculum is derivative - circular and transparent, concave on the outer surface and with a rudiment of a concentric line.

Differential diagnosis: This species is distinctive among all other congeners due to the combination of the following characters: axial ribs widely-spaced, rather high and lamella-like becoming much denser at the constriction. Spiral striae are lacking at 300x magnification on early whorls but is present on early whorls, the columella is provided with outwards directed basal knob.

Ecology: This species inhabits both primary and disturbed lowland rainforest and gardens.

Distribution: Southernmost North Moluccas: Obira Island of Obi Islands group.

Conservation status: Data Deficient, DD. This species known from southern part of Obira, the main island of Obi group. Not enough data available to calculate current EOO. The total area of Obi Islands is about 5100 km². It is very unlikely *Palaina obiensis* sp. nov. occurs all over Obi Islands and

only small fractions of Obi rainforests known to be located on limestone soils. Consequently, the maximum EOO for this species is certainly below 5000 km². The current AOO is 8 km², but the maximum AOO estimated up to 2000 km². The area of Obi Islands covered by rainforests is decreasing continuously, between 2001 and 2014 about 11000 ha of the rainforest were lost (calculated for canopy density over 25% according to the Global Forest Watch (2016)). Considering rapidly growing human population of the Moluccas together with presence of large nickel mine in W Obira (which attract additional workers from other regions of Indonesia), this trend is likely to continue. On the other hand, *P. obiensis* sp. nov. found also in gardens and secondary rainforests. There is no confirmation the population is suffering from habitat degradation. Two locations are known. Additional basic research is required. Threats to be highlighted for this species.

***Palaina* (s. l.) *onin* sp. nov.** (Fig. 80, plate 43 figs 6-12, map 27)

<http://zoobank.org/AD43FC3E-721E-4046-B97D-050AAF383939>

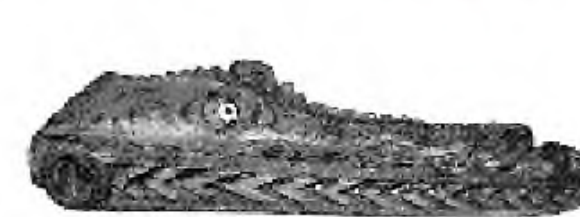
Holotype NME: INDONESIA E, West PAPUA, Onin Peninsula, Fak-Fak 10 km E, 2°56'32"S, 132°23'01"E, Sakarteman vill. 1-4 km W, River Sakarteman valley, 350-450 m, 26.IX.2010, primary lowland rainforest on limestone, leg. K.Greke.

Paratypes 12 specimens: 2 adults, 2 subadult & 2 juv. KGC, 1 adult, 2 subadults & 4 juv. NME: same label as holotype.

Derivatio nominis: Toponymic. This species is named after Onin Peninsula and a local language in the area where this species occurs. Noun in apposition, invariable.

Measurements: Holotype H = 2.4 mm, D = 1.6 mm, HW = 1.8 mm, PD = 1.2 mm. Selected paratype specimen H = 2.35 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1 mm.

Description: Shell is small, yellowish to pale brown, sinistral, obese with conical apex. Shell with 5½ strongly convex whorls, the 1½ embryonic whorl is smooth. The suture is deeply impressed. The ultimate whorl is strongly constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short zone of stronger oblique and denser axial ribs and the suture with a cavity-like impression above the constriction. The constriction is more or less centered in apertural view. The protoconch is placed oblique on the rest of the shell. The teleoconch is sculptured with very delicate dense slightly sinuous axial ribs. There are no



abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 6-7 ribs per 0.5 mm. The ribs becoming more distant and coarser on the last half whorl. Spiral striae are distinct, delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The columellar margin of the inner peristome is sinuous or slightly sinuous. The outer peristome is thick (in lateral view), provided with two obtuse protrudings - one on each

the palatal and the columellar margins (Plate 43 figs 6, 8-9). The palatal and the columellar margins of the outer peristome are sinuous. The basal margin of the outer peristome is reflexed. The columella is smooth, narrow and provided with a median columellaris. The operculum is derivative - thin and transparent, in a form of a flying disc with raised margin, small and narrow Γ-like median protruding (“handler”) on the inner surface, bears concentric lines.

Differential diagnosis: This species is conchologically very similar to *Palaina bicornis* van Benthem Jutting, 1958 and *P. misoolensis* sp. nov. (both from Misool Island), but is specifically different (consider characters discussed in table 16).

Table 16. Papuan species of *Palaina* s. l. similar to *P. onin* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. onin</i> sp. nov.
<i>Palaina bicornis</i>	the operculum with large and broad straight median protruding, without concentric lines, spiral striae less distinct, shell broadly fusiform, the penultimate whorl clearly the widest, the ultimate whorl constricted.	the operculum with short and narrow Γ-like median protruding, with concentric lines, spiral striae are distinct, shell broadly cylindrical, the penultimate whorl the widest, the ultimate whorl is weakly constricted.
<i>P. misoolensis</i> sp. nov.	the columella with a median knob which is visible in the aperture in lateral view, the operculum without concentric lines, shell broadly fusiform with the penultimate whorl clearly the widest, strongly conical and constricted on the ultimate whorl.	the columella without knob, the operculum with concentric lines, shell either broadly cylindrical, obese, with the penultimate whorl the widest but conical and the ultimate whorl is weakly constricted.

Ecology: This species was found in primary lowland rainforest on limestone in leaf litter on the undersides of fallen leaves. Reported from altitudes of 350-450 m.

Distribution: New Guinea: Onin Peninsula.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The maximum EOO estimated over 4000 km² taking into account the area of Onin Peninsula and available habitat. The current AOO is 4 km². The maximum AOO is likely much higher. The population size and trend are unknown. Onin Peninsula is still very pristine and covered by primary rainforests for over 75%. However, human population is growing and local development is ongoing, especially in coastal areas. Hitherto no large scale deforestation documented for Onin Peninsula. Significant decline in EOO, AOO or quality of habitat cannot be projected for this species within next 10 years. Further research is required on distribution of this species, its population trend and on threats.

***Palaina* (s. l.) *papuamontis* sp. nov.** (Fig. 81, plate 43 figs 13-20, map 27)

<http://zoobank.org/1A31D4CB-CE9D-4103-B655-8A596ED7BA7C>

Holotype UF (No 508075): UF 475413 Mollusca, Diplommatinidae, 6-spec. *Palaina* Papua New Guinea, Hela province Kielokana, 3.9 km SW of Tangi 2172 meters mossy pandanas [sic!] forest -5.6683° 142.624° 3 Apr 2009, JDS-0974 John Slapcinsky, Robert Lasley 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS 974 [handwritten].

Paratypes 31 specimens: 5 adults & 1 subadult UF: same labels as holotype; 16 adults, 4 subadults & 1 juv. UF, 4 adults KGC: UF 475459 Mollusca, Diplommatinidae, 2-spec. *Palaina* Papua New Guinea, Hela province large sinkhole, 6.1 km SW of Tangi 2400 meters forested sinkhole -5.6781°, 142.6161° 4 Apr 2009, JDS-0975 John Slapcinsky, Robert Lasley 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS-975 [handwritten].

Derivatio nominis: This species is named from a combination of Papua + Latin “montis” [mount], what should point on a connection with New Guinean mountains where this new species occurs. Noun in apposition, invariable.



Measurements: Holotype H = 2.2 mm, D = 1.3 mm, HW = 1.2 mm, PD = 0.8 mm. Selected paratype specimens: H = 2.25 mm, D = 1.4 mm, HW = 1.25 mm, PD = 0.8 mm; H = 2.2 mm, D = 1.2 mm, HW = 1.2 mm, PD = 0.75 mm; H = 2.1 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.7 mm; H = 1.95 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.75 mm; H = 1.95 mm, D = 1.15 mm, HW = 1.2 mm, PD = 0.7 mm; H = 1.9 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.7 mm.

Description: Shell is small, whitish, yellowish or pale brown, sinistral, cylindrical, with conical apex. Shell with 5½ convex whorls, the 1½ embryonic whorl is microgranulate. The suture is deeply impressed. The ultimate whorl is constricted, nearly as wide as the penultimate whorl in apertural view. Umbilicus is very narrowly open in adult, perspective. The constriction is very poorly defined by a short zone of slightly denser axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight axial ribs. The ribs becoming very flat and slightly curved on the upper part of the teleoconch whorls (Plate 43 fig. 17). Therefore a narrow smooth spiral line developed on the top of all teleoconch whorls. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are straight or almost straight to the coiling axis. There are 9-11 ribs per 0.5 mm. The ribs becoming stronger but not more distant on the last half whorl. Spiral striae are very delicate and dense. The aperture is not tilted against the coiling axis, ascending, circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple, forms a narrow continuous polished callus which is discontinued parietally. There are 2-3 strong lamellae on tuba near the peristome in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The margins of the peristome are not sinuous. The columella is smooth and broad, with a flat median callus which is directed backwards. The operculum is derivative - circular, rather high, consist of several layers of concentric ridges, with a medial hollow on the inner surface.

Differential diagnosis: This species is conchologically very similar to *Palaina citrinella* van Benthem Jutting, 1963 (northern New Guinea: Lake Sentani surroundings) but differs specifically in smaller shell (2.25 mm compared to 3.5 mm in *P. citrinella*) with narrowly open umbilicus (the umbilicus is closed in *P. citrinella*) and axial ribs disappearing on the top of the teleoconch whorls (axial

ribs are complete in *P. citrinella*). *Palaina erythropeplos* van Benthem Jutting, 1958 (Misool Island) is similar in shell shape and narrowly open umbilicus but is significantly larger (H = 3.4-4 mm), has the ultimate whorl significantly broader than the penultimate whorl (in apertural view) and the aperture is broader in this species than in *P. papuamontis* sp. nov.

Ecology: This species occurs in primary mid montane rainforests at altitudes about 2050-2200 m.

Distribution: Central Cordillera: Hela Province of PNG.

Conservation status: Near Threatened, NT. Not enough data available to calculate current EOO. The maximum EOO for this species estimated about 1000 km² taking into account the area of mid montane rainforests around the locus typicus. The current AOO is 8 km², maximum AOO estimated much less than 500 km². According to the Global Forest Watch (2016), montane area covered by rainforest around the locus typicus of *Palaina papuamontis* sp. nov. is currently stable and almost unaffected by deforestation, but deforestation is rapidly ongoing in lower areas - adjacent valleys. Hitherto, major threats are unknown for *P. papuamontis* sp. nov. and further research activities are required to evaluate population size, trend and highlight threats.

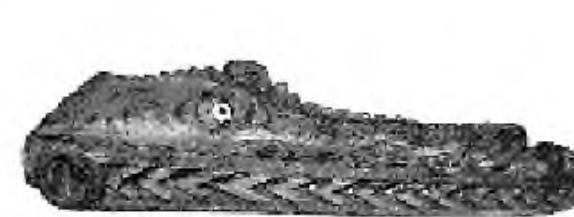
***Palaina* (s. str.) *papuanorum* Soós, 1911** (Plate 43 figs 21-24, map 26)

Lectotype NMNL: Sattelberg.

References: Soós (1911: 349); Leschke (1912a: 145); van Benthem Jutting (1963: 703); Wiktor (1998: 19), lectotype designation.

Measurements: Lectotype H = 2.4 mm, D = 1.3 mm, HW = 1.2 mm, PD = 1 mm.

Description: Shell is small, whitish with corneous coloured apical whorls, sinistral, rather broadly conical with conical apex. Shell with 5½ slightly convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The penultimate whorl is large and bulbous. The ultimate whorl is constricted, descending, it is much narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a shallow impression and a zone of denser placed axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse distant straight or slightly sinuous axial ribs. The ribs are 2-3x denser on earlier whorls. The ribs becoming dense on the apertural side of the ultimate whorl and getting very widely-spaced again on the rest of tuba. There are abrupt



changes in the ribbing pattern - early whorls with denser axial ribs which become abruptly replaced by distant ribs on last two whorls. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9 ribs per 1 mm, but twice more at the constriction. Spiral striae are very delicate. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is double, with a zone of dense irregularly sinuous lamellae on the ultimate whorl prior the aperture in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a broad continuous polished callus. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: According to its original description, type series collected “in woods, under fallen leaves” Soós (1911).

Distribution: New Guinea: northern (West Sepik Province, PNG) and eastern (Morobe Province, PNG) coast.

Conservation status: Data Deficient, DD. This species known from over 100 years old record and has not been collected again. Its distribution, habitat and threats remain unknown.

Remark: 25 specimens mentioned by Soós (1911) for the type series and Seleo Island (small islet offshore northern New Guinea) is given as the locus typicus. Wiktor (1998) designated one specimen from Sattelberg (Huon Gulf, eastern New Guinea) as the lectotype saying “there exist [sci!] only a single specimen, designated as a syntype, that has been transferred from L. Soós’s collection to that of Amsterdam”. Another 24 syntypes got lost in the fire in the Hungarian Natural History Museum. It remains unknown why the present lectotype has a different label from what is mentioned in the original description of this species.

***Palaina* (s. l.) *paradisaea* sp. nov.** (Fig. 82, plate 44 figs 1-7, map 21)

<http://zoobank.org/C6A7FED1-AE26-463A-B812-3BF23F66B9D6>

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Majalibit Bay, Waisai 19 km NE, River Werabiai valley, 00°18'02"S, 130°56'00"E, 40-60 m, 20.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 9 specimens: 4 adults KGC & 3 adults NME: same label as holotype; 2 adults KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10 km NWW, 00°24'46"S, 130°44'11"E, 70-200 m, 19.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: This species was found near the lekking ground of Wilson’s bird-of-paradise therefore the name for this new species should point to the habitat connection of this tiny soil snail and the Bird-of-paradise. The name may also refer to Raja Ampat enigmatic landscape and untouched nature.

Measurements: Holotype H = 1.9 mm, D = 1.1 mm, HW = 0.95 mm, PD = 0.8 mm. Selected paratype specimens from type locality: H = 1.95 mm, D = 1.15 mm, HW = 0.95 mm, PD = 0.8 mm; H = 1.8 mm, D = 1.15 mm, HW = 0.95 mm, PD = 0.8 mm; H = 1.8 mm, D = 1.1 mm, HW = 1 mm, PD = 0.75 mm. Selected paratype from 10 km NWW Waisai: H = 2 mm, D = 1.15 mm, HW = 1.1 mm, PD = 0.9 mm.

Description: Shell is very small, pink, yellowish or pale brown, sinistral, cylindrical with flattened apex. Shell with 5¼ convex whorls, the 1¼ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl strongly constricted, nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by shallow impression on the suture above it. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate dense straight axial ribs. There are abrupt changes in the ribbing pattern - the ribs becoming coarser and twice more distant beyond the constriction. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 12-13 ribs per 0.5 mm. Spiral striae are delicate, very dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The palatal and columellar margins of the inner peristome are strongly sinuous, of the outer peristome - less strongly sinuous. The inner peristome provided with obtuse ear-like protrudings on the parietal / palatal and the columellar / parietal junctions (Plate 44 figs 1, 3-4). The outer peristome is broadly discontinued parietally. The columella is smooth and glass-like semitransparent, provided with a large backwards directed knob all along its length. The operculum is derivative - in a form of a flying disc, with raised margin and concentric lines. Differential diagnosis: This species is distinctive among all congeners due to the combination of the following characters: shell cylindrical, the inner peristome with two protrudings on the palatal



and the columellar margins, Columella with a large knob which is directed backwards.

Ecology: This species occurs in primary lowland rainforests on limestone soils at altitudes 40-200 m. Specimens observed in wet leaf litter and under decaying wood at base of limestone outcrops and in deep leaf litter accumulated at buttress roots of large trees.

Distribution: Raja Ampat Islands: Waigeo Island.
Conservation status: Least Concern, LC. This species inhabits both western and eastern peninsulas of Waigeo, hitherto recorded from localities in the southern part of the island. Not enough data available to calculate current EOO. The maximum EOO estimated below 5000 km² (the area of Waigeo Island and adjacent islets considering available habitat). The current AOO is 8 km², but maximum AOO estimated below 500 km². The population size is unknown, but *P. paradisaea* sp. nov. is locally abundant. The population is not yet fragmented. The main threats are habitat lost and altering due to conversion of rainforests into gardens, timber collecting and small-scale logging. Growing human population of southern Waigeo and increasing tourism in the area (both national and international) demand more gardens, roads and resorts. Waigeo got a regency capital of Raja Ampat administrative province of Indonesia resulting in boosting development. Waigeo is rich in limestone rocks which are widely used for roads and buildings construction. Growing population (partly a result of immigration from other islands of Indonesia) requires more firewood and charcoal. *P. paradisaea* sp. nov. was not observed in disturbed forests but probably will survive also in a secondary lowland rainforests with closed canopy (wet litter is the key). Between 2001-2014 south-western Waigeo lost just about 1100 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)) but not in the area where *P. paradisaea* sp. nov. occurs. Therefore I can't project significant decline in AOO or EOO for this species within next 10 years. Additional basic research is required.

***Palaina* (s. l.) *perspectiva* sp. nov.** (Figs 83-84, plate 44 figs 8-11, map 24)

<http://zoobank.org/B1FE2EC8-6207-4FF8-BCC0-AF0C98EA46B5>

Holotype NME: INDONESIA E, W New Guinea, Doberai Peninsula, Ayamaru vill. ~15,5-14 km N, 1°08'04"S, 132°10'59"E to 1°09'29S, 132°11'30"E, ~275-250 m, 02.IX.2015, primary lowland rainforest on limestone, leaf litter, leg. D.Telnov.

Paratype 1 adult KGC: same label as holotype.

Derivatio nominis: Named from Latin "perspecto" to point out wide shell umbilicus of this species.

Measurements: Holotype H = 2.6 mm, D = 1.85 mm, HW = 1.6 mm, PD = 1.4 mm. Paratype H = 2.8 mm, D = 1.9 mm, HW = 1.5 mm, PD = 1.35 mm.

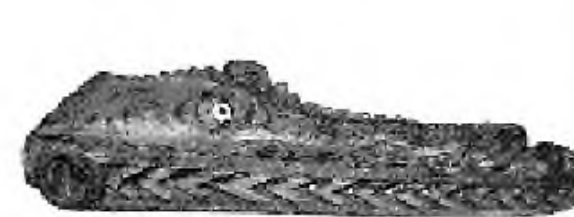
Description: Shell is small, white (body yellow), sinistral, conical with a conical apex. Shell composed of 5¾ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted and is about as wide as the penultimate whorl in apertural view. The umbilicus in adult shells is very broadly open and perspective for about one whorl. The constriction is well defined by a short shallow impression and much denser pattern of axial ribs. The constriction situated on same axis with the columellar side of the aperture. The protoconch is placed oblique on the rest of the shell. The teleoconch is sculptured with coarse widely-spaced and distinctly sinuous axial ribs (like high lamellae). The ribs becoming coarser and more widely-spaced on the last half whorl. At the constriction the ribs are 3x denser. The ribs are not synchronized with those on the previous whorls and are oblique to the coiling axis. There are 5-6 ribs per 0.5 mm. Spiral striae are very delicate and dense. The aperture is not tilted against the coiling axis is circular and has entire peristomal rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is double and thin in lateral view. The ultimate whorl with a broad zone of dense lamellae prior to the aperture. The parietal margin of the inner peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The palatal, basal and columellar margins of both peristomes are sinuous or slightly sinuous. The columella is broad, strongly widening at base. Operculum is unknown.

Differential diagnosis: This is very distinctive species due to the strongly left shifted aperture, lamella-like axial ribs and broadly open umbilicus.

Ecology: Specimens sampled from leaf litter in primary lowland rainforest on limestone.

Distribution: New Guinea: lowlands of Doberai Peninsula.

Conservation status: Near Threatened, NT. Not enough data available to calculate current EOO. The maximum EOO for this species estimated 8-10000 km² taking into account its possible distribution on southern Doberai Peninsula. The current AOO is 4 km², but maximum AOO estimated significantly larger. The population size is unknown, but this species was only found at one site in the



region, where over 25 sites were sampled. Habitat loss and the decline in habitat quality caused by logging, mining, and conversion of forests into gardens and plantations, as well as due expansion of settlements in lowland areas are the main threats. Between 2001 and 2014 more than 10000 ha of rainforest were lost in S Doberai (calculated for 25% canopy density, according to the Global Forest Watch (2016)). Continuing decline in extent and quality of habitat is observed and projected taking into account constantly growing human population of Doberai Peninsula. Further basic research is essential in order to clarify population size and trend and highlight threats.

***Palaina* (s. l.) *polystoma* B. Rensch, 1931** (Figs 85 & 98, plate 44 figs 12-20, map 14)

Holotype MHUB: Sunda-Expedition Rensch Fundort: [printed] Rana Meré (12-1300 m) W. Flores [handwritten] Datum: [printed] 19.-29.6.27 [handwritten] No: [printed] / Zoolog. Museum Berlin [printed] *Palaina polystoma* Rensch * Rana Meré, W. Flores 19.-29.6.27. Rensch leg 75441 [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina polystoma* Rensch Zool. Jahrb. Syst., 61, p. 395, Fig. 15, 1931 [handwritten] [label red].

Additional material: 3 KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.321'S, 120°31.463'E, 1535 m, 08.III.2011, primary lower montane rainforest, soil sample No 1, leg. A.Riedel; 4 KGC & 2 NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°38.099'S, 120°31.745'E, 2205 m, 09.III.2011, primary mid montane rainforest, soil sample No 3, leg. A.Riedel; 1 KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.781'S, 120°31.184'E, 1730 m, 10.III.2011, primary mid montane rainforest, soil sample No 8, leg. A.Riedel; 4 KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.641'S, 120°31.204'E, 1685 m, 10.III.2011, primary lower montane rainforest, soil sample No 9, leg. A.Riedel; 4 KGC: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37'48.1"S, 120°31.41'E, 1610 m, 10.III.2011, primary lower montane rainforest, soil sample No 10, leg. A.Riedel; 8 KGC & 8 NME: INDONESIA, Nusa Tenggara, Flores Is., Gn. Ranaka mt., 08°37.386'S, 120°31.156'E, 1575 m, 10.III.2011, primary lower montane rainforest, soil sample No 11, leg. A.Riedel; 1 KGC: INDONESIA, Nusa Tenggara, Flores Is., Tebedo, 08°29.848'S, 119°59.633'E, 525 m, 14.III.2011, primary lowland rainforest, soil sample No 1, leg. A.Riedel.

References: Rensch B. (1931: 390).

Measurements: Holotype H = 3.5 mm, D = 1.95 mm, HW = 1.8 mm, PD = 1.5 mm. Selected specimens from Mt. Ranaka, Flores Island: H = 3.5 mm, D = 1.9 mm, PD = 1.55 mm; H = 3.3 mm, D = 1.85 mm, PD = 1.55 mm; H = 3.3 mm, D = 1.9 mm, PD

= 1.6 mm; H = 3.1 mm, D = 1.8 mm, PD = 1.5 mm. Specimen from Tebedo, Flores Island: H = 3.9 mm, D = 2.2 mm, PD = 1.65 mm.

Description: Shell is large, pale brown, dextral, cylindrical with conical apex. Shell with 7 convex whorls, the 1^{1/2} embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is constricted, as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is delimited by a flat impression. The constriction is more or less centered in apertural view. There is a strong bulb just beyond the constriction above the columellar side of the aperture. The teleoconch is sculptured with fine very dense straight or slightly sinuous axial ribs. The ribs becoming very widely-spaced and strong on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 35 ribs per 1 mm, but about 22 ribs on the apertural side of the ultimate whorl. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thick in lateral view and consists of numerous delicate lamellae. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus. The margins of the inner peristome are not or slightly sinuous. The outer peristome is broadly discontinued parietally, its palatal margin is slightly sinuous. The columella is shny, slightly twisted and widened basally, provided with a small glass-like semitransparent basal callus. The columella is visible in the aperture in a form of a flat callus. The operculum is derivative - circular with concentric ridges on the outer surface.

Ecology: This species inhabits primary lowland, lower and mid montane rainforests up to 2200 m altitude. Specimens occur in wet leaf litter, usually on undersides of fallen leaves.

Distribution: Lesser Sunda Islands: Flores Island. Conservation status: Endangered, EN B2ab(ii,iii). The current EOO is ~400 km². The maximum EOO estimated ~15000 km² taking into account the area of Flores and adjacent islands. The current AOO is about 21 km², however the maximum AOO is likely higher, but definitively below 500 km². The population size and trend are unknown, but *Palaina polystoma* is not uncommon in primary rainforests on Flores. The population is not severely fragmented, but the grade of fragmentation is likely



to increase. The main threats for this species are loss and altering of the habitat due to timber collecting, small-scale logging and expansion of gardens. This results in habitat alteration, fragmentation and decline in the AOO. Growing human population of Flores combined with more frequent and longer dry periods caused by global warming and El Niño weather patterns will likely have continued negative effect on the remaining natural rainforests of Flores. Between 2001 and 2014, Flores, its adjacent islands of Lembata, Adonara, Solor and Rinca lost almost 29000 ha of rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)). This trend is likely to cause a continuing decline in the AOO. There are two known locations for *P. polystoma*.

***Palaina* (s. l.) *ponsonbyi* Sykes, 1903** (Plate 44 figs 21-25, map 20)

Holotype BMNH: ~~Diplom. sp.~~ [original correction] *Palaina ponsonbyi* Sykes Waigiou I. 1903.7.11.30-2 [handwritten] / *ponsonbyi*, Sykes. Waigiou I. [handwritten].

Paratypes 5 adults: 2 BMNH: same labels as holotype; 1 MMUE: [one circular label with written on both sides] D. (*Palaina*) *ponsonbyi* Sykes Waigiou. Cotype [handwritten, upper side] EE3846. Diplommatina *Palaina ponsonbyi* Sykes Waigiou Co-type [handwritten, under side] / 1028 [printed]; 2 FMNH: 72960 [printed] / 72960 FIELD MUSEUM OF NATURAL HISTORY MOLLUSCA: DIPLOMMATINIDAE 2 dry spec. Paratype(s): *Palaina ponsonbyi* Sykes, 1903 Sta. FMNH72960, Indonesia, West Papua, New Guinea, Waigiou ex F.F. Laidlaw ex E.R. Sykes (Acc.# 11666) [printed].

Additional material 10 adults, 2 subadult & 1 juv. LKCNHM: Indonesia: West Papua [sic!], Waigeo, Lopintol, Gua Kalepale. Leg. T. Whitten, Jan. 2013.

References: Sykes (1903a: 66); Sykes (1903b: 78, pl. 6 fig. 13); van Benthem Jutting (1963: 703). Measurements: Holotype H = 4.8 mm, D = 2.4 mm, HW = 2.3 mm, PD = 2 mm; Selected specimens from Lopintol vill.: H = 4.75 mm, D = 2.5 mm, HW = 2.3 mm, PD = 1.6 mm; H = 4.6 mm, D = 2.4 mm, HW = 2.1 mm, PD = 1.6 mm; H = 4.5 mm, D = 2.2 mm, HW = 2.35 mm, PD = 1.7 mm.

Description: Shell is very large, pale brown, sinistral, high conical with conical apex. Shell with 7 convex whorls, the $1\frac{3}{4}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well delimited by a short, moderately deep impression and abruptly changing ribbing pattern (the axial ribs becoming denser at the constriction). The

constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense irregular sinuous axial ribs. The ribs widen lamella-like on the upper parts and bent in a direction opposite to the coiling axis. In holotype, the ribs becoming very distant and strong on the last half whorl (however, this specimen has a kind of aberrant shell). The ribs are conspicuously less strong in paratype specimen from MMUE. There are abrupt changes in the ribbing pattern in the (aberrant) holotype only (see above), but not in recent material or paratypes. The ribs are not synchronized with those of the previous whorls and are oblique to strongly oblique to the coiling axis. There are about 9-12 ribs per 1 mm, but ~14-16 ribs per 1 mm at the constriction. Spiral striae are lacking. The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view or is slightly shifted left. The peristome is double and broad, consists of several thin lamellae. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus, expands and covers over a half of the ultimate whorl in apertural view. The margins of the inner peristome are not sinuous or the palatal margin is slightly sinuous. The outer peristome is broadly discontinued parietally (not in MMUE paratype), its palatal margin is slightly sinuous. The columella is simple and flat. Operculum is unknown.

Ecology: Unknown. Waigeo Island is covered by primary lowland rainforests on limestone soils.

Distribution: Raja Ampat Islands: Waigeo Island, Majalibit Bay. Co-ordinates of Gua [cave] Kalepale are 00°17'18"S, 130°49'15"E, but no information is available where exactly these specimens were sampled.

Conservation status: Data Deficient, DD. This species is known from four specimens collected over 115 years ago as well as from a small series of recently collected material. Exact locality on Waigeo is unknown for historical specimens. Not enough data available to calculate current EOO. The current AOO is 4 km². The maximum EOO is definitively below the threshold of 500 km² (the total area of Waigeo and adjacent islets considering available habitat). Further research is required on population size of this species and its threats.

***Palaina* (s. l.) *propinqua* van Benthem Jutting, 1963** (Plate 44 figs 26-29, map 27)

Holotype NMNL: Papua, Biak, Jobdi, Afd. Mariniers Nieuw Guinea, 1953.



Paratypes 4 adults NMNL: Yapen Island, sago swamp near Sarmi, along road to the airport.

References: van Benthem Jutting (1963: 708, pl. 29 fig. 29).

Measurements: Holotype H = 3.3 mm, D = 2.1 mm, HW = 1.65 mm, PD = 1.6 mm.

Description: Shell is large, whitish, sinistral, obese with flattened apex. Shell with 6 strongly convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The penultimate whorl is slightly bulbous. The ultimate whorl slightly constricted and ascending, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a broad impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse dense sinuous axial ribs. The ribs becoming more widely-spaced and strong on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 10-11 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick in lateral view and consists of several thin lamellae. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a very broad continuous polished callus, expands and covers most of the ultimate whorl. The columellar margins of both peristomes are slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: On Yapen this species was sampled in sago swamp.

Distribution: Cenderawasih Bay Islands: Biak Island, Yapen Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species is not clear since *P. propinqua* is not limited to Biak Island and also inhabits Yapen. The fauna of Yapen is shared with Waropen region of New Guinea. Since this species was found in coastal sago swamp on Yapen and taking into account that most of Waropen region is also swampy, occurrence of *P. propinqua* on this part of New Guinea could not be excluded. The maximum AOO estimated over the threshold of 500 km². This species is known from a series sampled about 70 years ago and has not been collected

again. Threats for this species are unknown. Sago swamps are generally not threatened in the Papuan Region. Further research is required to highlight status of *P. propinqua* in the wild, calculate population size, clarify its trend and clarify threats for the population.

***Palaina* (s. l.) *psittricha* sp. nov.** (Figs 86 & 142, plate 45 figs 1-9, map 16)

<http://zoobank.org/5A4090D4-4D57-44B0-91CD-E5FE5F1A9B54>

Holotype NME: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 43 specimens: 28 adults KGC & 10 adults NME: same label as holotype; 4 adults & 1 juv. KGC: INDONESIA E, Raja Ampat, Misool Island (central), River Gam upstream, Gamta vill. 12-14 km NW, 01°57'50"S, 130°11'09"E, 350 m, 06.II.2012, primary lowland rainforest, limestone rocks, leg. D.Telnov.

Derivatio nominis: This species is named after the Papuan endemic Pesquet's parrot *Psittrichas fulgidus* (Lesson, 1830). The first observation of Pesquet's parrot from Misool Island (not yet published) was made by Dmitry Telnov at the same day when *Palaina psittricha* sp. nov. specimens were sampled. This epithet is an adjective.

Measurements: Holotype H = 1.7 mm, D = 1 mm, HW = 0.8 mm, PD = 0.7 mm. Selected paratype specimens from locus typicus: H = 1.8 mm, D = 0.95 mm, HW = 0.8 mm, PD = 0.7 mm; H = 1.65 mm, D = 0.95 mm, HW = 0.7 mm, PD = 0.6 mm; H = 1.65 mm, D = 0.9 mm, HW = 0.8 mm, PD = 0.7 mm.

Description: Shell is very small, white or yellow with yellow body, sinistral, cylindrical with conical apex. Shell with 6 convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The protoconch is placed somewhat oblique on the rest of the shell. The ultimate whorl is slightly constricted, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. There is a vague sutural impression above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight or slightly sinuous ribs. There are abrupt changes in the ribbing pattern - the ribs becoming coarse and twice more distant beyond the constriction. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 9-10 ribs per 0.5 mm. Spiral striae are very delicate and dense. The aperture is not tilted



to the coiling axis and is circular and has entire apertural rim. The position of the aperture is slightly shifted left the coiling axis in apertural view. The peristome is double, thick and consists of several dense lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. In certain specimens the palatal and the columellar margins of both peristomes are slightly sinuous. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The columella is simple and shiny, slightly widening basally. The operculum is derivative - circular and high, consist of several layers of concentric ridges.

Differential diagnosis: Most similar to *Palaina adelpha* Soós, 1911 (Eastern New Guinea) and *P. flavocylindrica* sp. nov. (Bird's Neck Isthmus of New Guinea; see description of this species above). The operculum is simple (without concentric ridges) in *P. flavocylindrica* sp. nov. and the ultimate whorl is not constricted, the aperture is centered below the penultimate whorl (the aperture is shifted left in apertural view in *P. psittricha* sp. nov.). The axial ribs are much coarser and distant in *P. adelpha*, no dense delicate lamellae present between the peristomes in this species, and the ribs becoming denser and delicate at the constriction (not the case in *P. psittricha* sp. nov.).

Ecology: This species occurs in primary lowland rainforests at altitudes about 300-350 m. Specimens were observed in wet leaf litter accumulated in cavities of limestone anticlines formations.

Distribution: Raja Ampat Islands: Misool Island. Conservation status: Least Concern, LC. Not enough data available to calculate current EOO. The maximum EOO is estimated less than 2000 km² taking into account the area of Misool and available habitat. Current AOO is 4 km². The maximum AOO estimated much higher but definitively below 500 km². The population size and trend are unknown. However, *Palaina psittricha* sp. nov. is locally common. There is one location. No major threats to this species have been identified. Misool Island is still very pristine and covered by primary rainforests for over 75%. Further research is required on distribution of this species as well as on its population size and trend.

***Palaina* (s. l.) *quadricornis* van Benthem Jutting, 1958** (Plate 45 figs 10-14, map 17)

Holotype NMNL: Papua, Misoöl, Fakal, 0-75 m M. Lief-tinck, 1948.10.07.

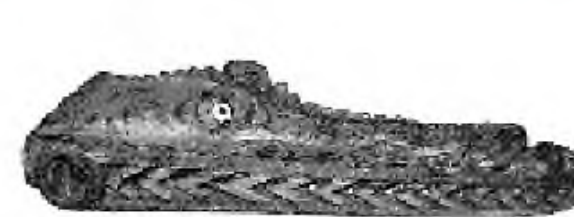
References: van Benthem Jutting (1958a: 295,

317); van Benthem Jutting (1963: 703).

Measurements: Holotype H = 3.8 mm, D = 2.3 mm, HW = 2.4 mm, PD = 1.5 mm. Selected para-types (according to the original description): H = 4.9 mm, D = 2.4 mm, PD = 1.9 mm; H = 3.9 mm, D = 2.4 mm, PD = 1.4 mm; H = 3.5 mm, D = 2.4 mm, PD = 1.4 mm.

Description: Shell is large with very thick wall, yellowish, greenish, reddish or brownish, yellowish or greenish, sinistral, very obese with conical apex. Shell with 6 rather flat whorls (except the penultimate one), the 1¹/₂ embryonic whorl is microscopically pitted. The suture is rather shallow but distinct. The penultimate whorl is slightly bulbous. The ultimate whorl is strongly constricted and slightly descending, narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly delimited by a broad shallow impression. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight ribs. The ribs becoming coarser and more distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 11-12 ribs per 1 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double. The parietal margin of the peristome is not fully attached to the ultimate whorl. The margins of the inner peristome are not or slightly sinuous. The outer peristome is broadly discontinued parietally, developed as a broad collar beyond the inner peristome. There are four obtuse protrudings on the outer peristome - two basal, one palatal and one columellar (Plate 45 figs 10-14). All margins of the outer peristome are strongly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Unknown. Misool Island is covered by primary lowland rainforests on mostly limestone soils. Distribution: Raja Ampat Islands: Misool Island. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO is estimated less than 2000 km² taking into account the area of Misool and available habitat. The maximum AOO is estimated below 500 km². The population size and trend are unknown. *P. quadricornis* was sampled from single locality about 70 years ago. It was not found again by the 2009 and 2012 Misool expeditions by the Entomological Society of Latvia. Threats



for this species are unknown. Misool Island is still very pristine and covered by primary rainforests for over 75%. Further basic research is required to clarify status of this species in the wild, understand its distribution, estimate population size and highlight threats.

***Palaina* (s. l.) *repandostoma* van Benthem Jutting, 1963** (Plate 45 figs 15-17, map 26)

Holotype NMNL: Papua, Biak, woonkamp Marine, L.D.Brongersma.

References: van Benthem Jutting (1963: 706, pl. 29 fig. 27).

Measurements: Holotype H = 3.35 mm, D = 2.4 mm, HW = 2 mm, PD = 1.7 mm. Selected paratypic specimens (according to the original description): H = 3.2 mm, D = 2.4 mm, PD = 1.7 mm; H = 3 mm, D = 2 mm, PD = 1.5 mm.

Description: Shell is large, creamy coloured, sinistral, obese with flattened apex. Shell with $5\frac{1}{2}$ strongly convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted and ascending, it is nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short distinct impression and a cavity-like sutural impression above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight ribs. The ribs becoming stronger but not much distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 12 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is shifted left against the coiling axis in apertural view. The peristome is indistinctly double, very thick and consists of numerous thin lamellae in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The palatal and the columellar margins of both peristomes are slightly sinuous. The inner peristome forms a continuous polished callus, expands and covers most of the ultimate whorl. The outer peristome is broadly discontinued parietally. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Type specimens were sampled from leaf litter.

Distribution: Cenderawasih Bay Islands: Biak Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species is estimated 7800 km² taking into account the area of Biak, Supiori, Numfoor and adjacent islets. The maximum AOO estimated below the threshold of 500 km². This species is known from a small series of specimens sampled about 70 years ago from two close localities. Biak is widely known by high proportion of endemic malacofauna (e.g. van Benthem Jutting 1963). The population size and trend are unknown. Threats for this species are unknown. Further basic research is required to highlight status of the species in the wild, estimate the population size and highlight threats.

***Palaina* (s. l.) *scaveola* van Benthem Jutting, 1958** (Plate 45 figs 18-20, map 16)

Holotype NMNL: Papua, Misoöl, Waima, 0-75 m, 1948.09.13 M.A. Lieftinck.

References: van Benthem Jutting (1958a: 295, 315); van Benthem Jutting (1963: 704).

Measurements: Holotype H = 2.3 mm, D = 1.3 mm, HW = 1.2 mm, PD = 1 mm. Paratypic specimen (according to the original description): H = 1.9 mm, D = 1.1 mm, PD = 0.8 mm.

Description: Shell is small, whitish, sinistral, cylindrical with flattened apex. Shell with $5\frac{1}{4}$ convex whorls, the 1 embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is constricted and slightly ascending, it is about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a short distinct impression, is more or less centered in apertural view. The teleoconch is sculptured with delicate very widely-spaced sinuous axial ribs. The ribs becoming stronger but not more distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 7 ribs per 1 mm. Spiral striae are very delicate. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, consists of several strong lamellae in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The palatal and the columellar margins of both peristomes are strongly sinuous. The inner peristome forms a continuous polished callus, expands and covers most of the ultimate whorl. The



outer peristome is broadly discontinued parietally, with two obtuse protrudings near the palatal / parietal and the parietal / columellar junctions (Plate 45 figs 18-19). No specimens were available to study the internal lamellae. Operculum is unknown. Ecology: Unknown. Misool Island is covered by primary lowland rainforests on mostly limestone soils. Distribution: Raja Ampat Islands: Misool Island. Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated below 2000 km² taking into account the area of Misool and available habitat. The maximum AOO estimated below 500 km². The population size and trend are unknown. *P. scaveola* seems uncommon and was not found by the 2009 and 2012 expeditions of the Entomological Society of Latvia to Misool. This species is known from two localities in lowland rainforests on limestone soils. Threats for this species are unknown. Misool Island is still very pristine and covered by primary rainforests for over 75%. Further basic research is required on distribution of *P. scaveola*, its population size, trend as well as on threats.

***Palaina* (s. l.) *schneideri* I. et B. Rensch, 1929**
(Plate 45 figs 21-24, map 28)

Lectotype MHUB [herewith designated]: Zoolog. Museum Berlin [printed] 90936 *Palaina schneideri* I.+B. Rensch * Neu-Pommern Weite Bucht Karlei Ig. P. Schneider [handwritten] / Zoolog. Museum Berlin. Typus von: [printed] *Palaina schneideri* I. + B. Rensch Zool. Anz. 80, 1929, p. 85, Abb. 5 [sic! Fig. 6] [handwritten] [label red]. Paralectotype 1 adult MHUB [herewith designated]: same labels as lectotype.

Lectotype designation: Lectotype was selected from two syntypes, all with same labels.

References: Rensch I. & B. (1929: 85); Rensch I. (1937: 604).

Measurements: Lectotype H = 3.1 mm, D = 1.6 mm, HW = 1.5 mm, PD = 1.3 mm. Paralectotype H = 3.1 mm, D = 1.6 mm, HW = 1.45 mm, PD = 1.2 mm. According to Rensch I. (1937), smallest specimen has shell H about 2 mm.

Description: Shell is large, whitish, sinistral, high cylindrical with conical apex. Shell with 6 strongly convex whorls, the 1¹/₂ embryonic whorl is microscopically pitted. The suture is moderately deeply impressed. The ultimate whorl is strongly constricted, narrower than the penultimate whorl in apertural view. The tuba is prolonged (protruding from shell outline) and funnel-like widened (Plate 45 fig. 24). The umbilicus is closed in adult. The constriction is poorly defined by a short zone of stronger

distant axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate straight or slightly sinuous axial ribs. The ribs are widely-spaced on early whorls and the ultimate whorl, but very dense on the penultimate whorl. The ribs becoming much stronger but not much distant on the last half whorl. There are abrupt changes in the ribbing pattern - see above. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 22-24 ribs per 1 mm, but ~10-12 ribs on the apertural side of the ultimate whorl. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is indistinctly double, very thick and consists of numerous delicate lamellae in lateral view. The parietal margin of the peristome is not fully attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The outer peristome is discontinued parietally. The palatal margins of both peristomes are slightly sinuous. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: Type specimens found in riverine lowland rainforest.

Distribution: Bismarck Archipelago: New Britain Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO for this species estimated 145000 km² taking into account the area of New Britain, New Ireland and adjacent islets. The maximum AOO estimated below the threshold of 500 km². This species is known from a series of nearly 100 years old specimens. The population size and trend are unknown (however, Rensch I. (1937) stated this species was found in large series). Threats for this species are unknown. Further research is required to clarify status of this species in the wild, calculate population size and highlight threats.

***Palaina* (s. l.) *silvicultrix* sp. nov.** (Figs 87 & 115, plate 46 figs 1-3, map 20)

<http://zoobank.org/57EF6421-9257-4982-93B8-8A1DD1FC87EA>

Holotype LKCNHM: Indonesia: West Papua [sic!], Waigeo, Lopintol, Gua Kalepale, Leg. T. Whitten, Jan. 2013.

Paratypes 79 adults LKCNHM & 6 adults KGC: same label as holotype.

Derivatio nominis: Named from Latin “silvicul-



trix" [living in woods, forest dweller].

Measurements: Holotype H = 2.6 mm, D = 1.4 mm, HW = 1.5 mm, PD = 1.15 mm; Selected paratype specimens: H = 2.6 mm, D = 1.3 mm, HW = 1.4 mm, PD = 1.1 mm; H = 2.6 mm, D = 1.4 mm, HW = 1.5 mm, PD = 1.3 mm; H = 2.6 mm, D = 1.4 mm, HW = 1.45 mm, PD = 1.3 mm.

Description: Shell is small, whitish, sinistral, cylindrical, with broadly conical apex. Shell with 6 convex whorls, the $1\frac{3}{4}$ embryonic whorl is microgranulate. The suture is rather deeply impressed. The ultimate whorl is constricted and somewhat descending, it is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The protoconch is placed oblique on the rest of the shell. The constriction is poorly delimited by a broad and shallow impression and a zone of delicate axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced straight ribs. The ribs becoming coarser (significantly higher) and more distant on the ultimate whorl. The ribbing pattern is flat and delicate around and in the constriction. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 7 ribs per 0.5 mm. Spiral striae are lacking at x500 magnification. The aperture is not or slightly tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, very thin in lateral view. The columellar margin of the outer peristome is somewhat angulate (Plate 46 fig. 1). The inner peristome forms a broad continuous polished callus. The columella is rather broad and shiny. Operculum is unknown.

Differential diagnosis: No congeners with similarly shaped and ribbed shells are known from the study region. *P. granulum* I. et B. Rensch, 1929 (New Britain Island) is somewhat similar but this species differs specifically in more slender shell shape, strongly denser and less high axial ribs.

Ecology: Unknown.

Distribution: Raja Ampat Islands: Waigeo Island. Co-ordinates of Gua [cave] Kalepale are $00^{\circ}17'18''\text{S}$, $130^{\circ}49'15''\text{E}$, but no information is available where exactly these specimens were sampled.

Conservation status: Data Deficient, DD. This species is known from large series of specimens collected under unknown circumstances and the habitat of species is unknown. No information is available to calculate current EOO. The maximum

EOO is estimated no less than 65 km² taking into account Lopintol and adjacent area of West Waigeo. The current AOO is 4 km², the maximum AOO is certainly under 500 km². Threats are unknown. The population size and trend are unknown. Further research is required primarily to highlight distribution and habitat requirements of *P. silvicultrix* sp. nov. and calculate its population size.

***Palaina* (s. l.) *slapcinskyi* sp. nov.** (Fig. 88, plate 46 figs 4-11, map 26)

<http://zoobank.org/7C67D357-17E1-4991-8854-8B53FD83FB66>

Holotype UF (No 507372): UF 380639 Mollusca, Diplommatinidae 24 specimen(s) *Palaina* [printed] sp. 8 [handwritten] Papua New Guinea, Sandaun Province Smanmoke, base of S slope of Mount Sapau, 4 km NW of Parkop Village mature hill forest along river 561 meters -3.3926° 142.5298° Slapcinsky, J. 24 Mar 2005 JS-0800 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS 800 *Palaina*? [handwritten].

Paratypes 58 specimens: 10 adults, 1 subadult, 16 juv. UF & 3 adults KGC: same labels as holotype [2 adults are badly broken]; 2 adults & 11 juv. UF: UF 380587 Mollusca, Diplommatinidae 12 specimen(s) *Palaina* [printed] sp. 8 [handwritten] Papua New Guinea, Sandaun Province Wayayane, 1 km N of Parkop Village, 4 km NW of Sibilanga Mission hill forest 564 meters -3.4194° 142.5269° Slapcinsky, J. 16 May 2005 JS-0794 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / *Palaina* JS-794 [handwritten]; 10 adults & 1 juv. UF, 1 adult KGC: UF 380655 Mollusca, Diplommatinidae 13-spec. *Palaina* Papua New Guinea, Sandaun Province Wayayane, 1 km N of Parkop Village, 4 km NW of Sibilanga Mission hill forest 564 meters -3.4194° 142.5269° Slapcinsky, J. 16 May 2005, JS-0794 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JDS-794 [handwritten]; 2 adults & 1 subadult UF: UF 380673 Mollusca, Diplommatinidae 3-spec. *Palaina* Papua New Guinea, Sandaun Province Sinberien, base of S slope of Mount Sapau, 4 km NW of Parkop Village, 7 km NW of Sibilanga Mission wet hill forest along alkaline stream 526 meters -3.3975° 142.5288° Slapcinsky, J. 22 May 2005, JDS-0798 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / 798 [handwritten] [shells strongly dissolved]; 5 adults, 1 subadult & 7 juv. UF: UF 380572 Mollusca, Diplommatinidae 14 specimen(s) *Palaina* [printed] sp. 8 [handwritten] Papua New Guinea, Sandaun Province Sinberien, base of S slope of Mount Sapau, 4 km NW of Parkop Village, 7 km NW of Sibilanga Mission wet hill forest along alkaline stream 526 meters -3.3975° 142.5288° Slapcinsky, J. 22 May 2005 JS-0798 dry FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS-798 [handwritten]; 1 adult UF: UF 380732 Mollusca, Diplommatinidae 1-spec. *Palaina* Papua New Guinea, Sandaun Province Ataukbumbu, base of S slope of Mount Sapau, 4 km NW of Parkop Village, 7 km NW of Sibilanga Mission hill forest 550 meters -3.3934°



142.5318° Slapcinsky, J. 27 May 2005, JS-0806 75% ethanol FLORIDA MUSEUM OF NATURAL HISTORY [printed] / JS 806 [handwritten].

Derivatio nominis: Patronymic. This species is named after its first collector, famous malacologist and specialist on Papuan malacofauna, my dear colleague John Slapcinsky (UF).

Measurements: Holotype H = 2 mm, D = 1.1 mm, HW = 1 mm, PD = 0.8 mm. Selected paratypic specimens: H = 2.05 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.8 mm; H = 2 mm, D = 1.2 mm, HW = 1.05 mm, PD = 0.8 mm; H = 2 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.8 mm; H = 1.95 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.8 mm; H = 1.9 mm, D = 1.1 mm, HW = 1 mm, PD = 0.75 mm; H = 1.8 mm, D = 1 mm, HW = 1 mm, PD = 0.8 mm.

Description: Shell is small, whitish or yellowish, sinistral, narrow cylindrical with rounded apex. Shell with $5\frac{1}{3}$ convex whorls, the $1\frac{1}{3}$ embryonic of them are microgranulate. The suture is rather deeply impressed. The ultimate whorl is strongly constricted and descending, it is as wide as the penultimate whorl in apertural view. The umbilicus is extremely narrowly open in adult, not perspective. The constriction is poorly defined by a short shallow impression and a short zone of dense axial ribs. The constriction is more or less centered in apertural view. The teleoconch whorls sculptured with coarse distant straight ribs. The ribs becoming even more widely spaced on the last half whorl. There are abrupt changes in the ribbing pattern at the constriction (see above). The ribs are not synchronized with those on previous whorls and are straight to the coiling axis. There are 5 ribs per 0.5 mm. Spiral striae are delicate and very dense. The aperture is not tilted from the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, Peristomal margins are not sinuous. The inner peristome forms a polished callus which is discontinued parietally. The outer peristome is somewhat expanding beyond the inner one. The columella is smooth, very broad in upper half, narrowed towards base and provided with a flat median glass-like semitransparent callus which is directed backwards. The operculum is derivative - circular, shortly tubular with concentric peripheral growth ridges and medially hollow on the outer surface.

Differential diagnosis: This species is peculiar due to the combination of the following characters: the operculum is tubular with peripheral growth

ridges, shell small with distant and coarse axial ribs, the aperture is centered below the ultimate whorls and the umbilicus is very narrowly open.

Ecology: Specimens were sampled at altitudes 526-564 m in primary lowland rainforest on limestone, along streams and river.

Distribution: Northern New Guinea: Torricelli Mountains.

Conservation status: Least Concern, LC. The current EOO is about 20 km², but the maximum EOO is definitely much larger and may include large part of Torricelli Mountains. The current AOO is 8 km², the maximum AOO estimated below the threshold of 500 km². The population size and trend are unknown, but *P. slapcinskyi* sp. nov. seems not uncommon. Main threat for this species is unknown. Torricelli Mountains are still very pristine and covered with primary rainforests for over 80%. According to the data from Global Forest Watch (2016), no large or mid-scale deforestation reported from the area of occurrence of *P. slapcinskyi* sp. nov. I cannot project any significant changes in extent or quality of habitat for this species for the next 10 years. Further basic research is required on distribution, population size and threats for this species.

***Palaina* (s. l.) *solomonensis* (Dell, 1955) comb. nov.** (Plate 46 figs 12-14, map 19)

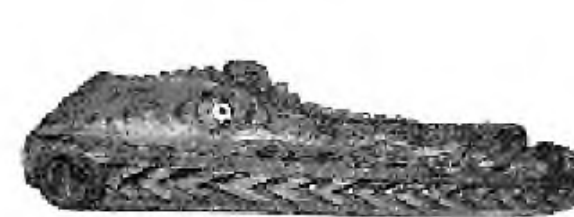
Holotype MONZ: M.202515, SOLI4403, Gardner, Norman 1944, Solomon Islands Treasury Islands Mono Island, ridge above Seveke River Leaf mould.

New combination: New combination is based on conchological characters. A little denticle on the columellar side of the aperture cannot be classified as generic character of *Diplommatina* since it is not supplemented by palatalis and parietalis.

References: Dell (1955: 423, 424), as *Diplommatina solomonensis*.

Measurements: Holotype H = 2.9 mm, D = 1.4 mm, HW = 1.4 mm, PD = 1.15 mm.

Description: Shell is small, pale rose with darker embryonic whorls, sinistral, narrow and high conical with convex apex. Shell with $6\frac{1}{2}$ convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is slightly constricted, as wide as the penultimate whorl in apertural view. The constriction is poorly defined by a short and shallow impression and a short zone of stronger sinuous axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced (particularly distant on early whorls and on the last half whorl), straight (on



central whorls) to slightly sinuous (on the apertural side of the ultimate whorl) axial ribs. The ribs becoming denser on the apertural side of the penultimate whorl. There are no abrupt changes in the ribbing pattern. The ribs are partially synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 15 ribs per 1 mm. Spiral striae are very delicate. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The parietal margin of the peristome is attached to the ultimate whorl. The peristome is double, very broad, consists of numerous dense lamellae in lateral view. The inner peristome forms a broad continuous polished callus. The palatal margins of both peristomes are sinuous. The columellar denticle is inconspicuous, not directed downwards. No specimens were available to study the internal lamellae (but there no palatalis or parietalis are visible through shell wall). Operculum is unknown.

Ecology: Specimens were sampled from leaf litter in lowland rainforest.

Distribution: Solomon Islands: Mono Island.

Conservation status: Data Deficient, DD. This species is known from a few historical specimens collected more than 50 years ago from one locality. The population size and trend are unknown. Threats are unknown. Further research is required.

***Palaina* (s. l.) *sparselamellata* sp. nov.** (Fig. 89, plate 46 figs 12-19, map 21)

<http://zoobank.org/B36F0D4E-F5C8-41DC-9C6E-D23CCCB23A84>

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 10-13 km NE, 00°21'17"S, 130°54'37"E, ~70 m, 16.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 3 adults KGC: same label as holotype [one adult is badly broken].

Derivatio nominis: Named from Latin "sparsus" [sparse, rare] + "lamella" to stress widely-spaced axial ribs of the shell.

Measurements: Holotype H = 2.05 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.9 mm. Selected paratype specimens: H = 1.9 mm, D = 1.2 mm, HW = 1.1 mm, PD = 0.9 mm; H = 1.9 mm, D = 1.2 mm, HW = 1.05 mm, PD = 0.8 mm.

Description: Shell is very small to small, brown to pale brown, sinistral, broadly cylindrical with flattened apex. Shell with 5 strongly convex whorls, the 1¼-1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl

is slightly constricted, about as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a short but deep impression, dense pattern and height reduction in axial ribs and by presence of a deep cavity-like impression on the suture above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with high lamella-like and rather widely-spaced straight or slightly sinuous ribs. The ribs becoming stronger and more distant on the last half whorl. There are abrupt changes in the ribbing pattern – the ribs are much denser on early whorls and at the constriction. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are 4-5 ribs per 0.5 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, consists of several strong lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally. The palatal margins of both peristomes are strongly sinuous. In fully grown specimens the parietal / palatal and the columellar / parietal junctions of the inner peristome expand in obtuse protrudings (Plate 46 figs 15 & 17). The columella is smooth, angulate medially. The operculum is derivative - with tuba-like concentric ridge on the outer surface.

Differential diagnosis: This species is distinctive due very distant ribbing pattern on the last half whorl. Similar *Palaina hartmanni* sp. nov. (Waigeo Island; see description of this species above) differs in having denser ribs on all the teleoconch whorls except for the last half whorl. The operculum in this species is with low ridge and its shell is generally smaller than in *P. sparselamellata* sp. nov.

Ecology: Specimens sampled from undersides of wet fallen leaves in primary lowland rainforest on limestone (karst area).

Distribution: Raja Ampat Islands: Waigeo Island. Conservation status: Data Deficient, DD. This species inhabits eastern peninsula of Waigeo, hitherto recorded from one locality in the southern part of the island. Not enough data available to calculate current EOO. The maximum EOO estimated below 5000 km² (the area of Waigeo and adjacent islets plus available habitat). Current AOO is 4 km², but the maximum AOO estimated up to 500 km². The population size is unknown, but only few speci-



mens were found during the field study. Main threat for this species is unknown. Growing human population of southern Waigeo and increasing tourism in the area (both national and international) demand more gardens, infrastructure and tourism resorts. Waigeo got a regency capital of Raja Ampat administrative province some years ago what resulted in boosting development. Waigeo is initially rich in limestone rocks and limestone is widely used for roads and buildings construction. Growing population (partly a result of immigration from other islands of Indonesia) requires more firewood and charcoal. Aforementioned facts are not yet reported from the eastern peninsula and currently there are no villages nearby the type locality of *P. sparselamellata* sp. nov. However, decline in primary lowland rainforests is projected also for this area, but definitively not for the next 10 years. Specimens of *P. sparselamellata* sp. nov. were not observed in disturbed forests. Additional research is required on distribution and ecological preferences of this species, its population size and trend.

***Palaina* (s. l.) *tanimbarensis* sp. nov.** (Fig. 90, plate 46 figs 20-22, map 15)

<http://zoobank.org/9C92C798-164A-409C-AD50-EF2A6CF1F7E3>

Holotype NMNL: Coll. J.J. Vermeulen, nr. 4728 Palaina indet. - Diplommatinidae 1995.06. INDONESIA. Tanimbar Islands; W part Yamdena Isl., near Kpg. Makatian. Undisturbed primary forest on limestone, near riverbed, 4-6 km from the sea (3-5 km from a brackish river). Leg. A.J. Whitten, 00/10/1995.

Paratypes 2 adults NMNL: same label as holotype.

Derivatio nominis: Toponymic. This species named after the Tanimbar Islands, its area of occurrence.

Measurements: Holotype H = 3.2 mm, D = 2.3 mm, HW = 2 mm, PD = 1.8 mm (1.2 mm without expansion of the outer peristome). Paratype specimens: H = 3.25 mm, D = 2.1 mm, HW = 2.1 mm, PD = 1.5 mm (1.15 mm without expansion of the outer peristome); H = 3.2 mm, D = 2.25 mm, HW = 2.05 mm, PD = 1.8 mm (1.1 mm without expansion of the outer peristome).

Description: Shell is large, creamy coloured, sinistral, cylindrical with flattened apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is slightly constricted, it is as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by a zone of low dense axial ribs.

The constriction is more or less centered in apertural view. The early 1½-3¼ teleoconch whorls covered with rather dense straight axial ribs. The ribs becoming very widely-spaced on the teleoconch whorls 3¼-6. The ribs are elevated and somewhat c-like bent on the periphery of each whorl, forming low lamella-like protrudings (Plate 90 figs 20-22). The ribs becoming even more distant on the last half whorl. There are abrupt changes in the ribbing pattern (see above). The ribs are not synchronized with those of the previous whorls. The ribs are oblique to the coiling axis. There are 2-3 c-like bent ribs per 1 mm. Spiral striae are very delicate and dense. The aperture is not tilted to the coiling axis, is oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. The outer peristome expands very strongly, wing-like beyond the inner peristome on the palatal, basal and columellar sides. Both the palatal and columellar margins of the outer peristome are slightly sinuous. The columella is thin and slightly curved, provided with a small prebasal fold. Operculum is unknown.

Differential diagnosis: This species is different from its sympatric congener *Palaina thomasrinteleni* sp. nov. (Yamdena Island; see description of this species below) by its sinistral and cylindrical shell (shell is conical, slender and dextral in *P. thomasrinteleni* sp. nov.), presence of complete high c-like bent axial ribs (axial ribs are incomplete and not lamella-like, either c-like bent in *P. thomasrinteleni* sp. nov.). *Palaina tanimbarensis* sp. nov. differs from another close sympatric congener *P. mirifica* sp. nov. (Yamdena Island; see description of this species above) by higher and less obese shell, bent axial ribs (ribs are straight in *P. mirifica* sp. nov.) and less stronger expanded outer peristome.

Ecology: Specimens found in primary riverine lowland rainforest on limestone soil.

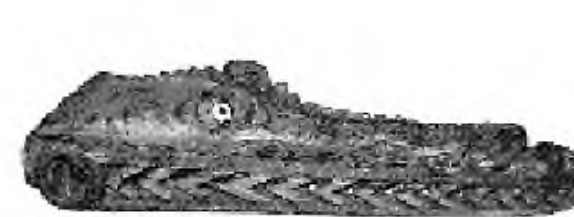
Distribution: Tanimbar Islands: Yamdena Island.

Conservation status: Data Deficient, DD. This species is currently known from a few individuals. Its habitat, population size and threats are unknown. Further basic research is required.

***Palaina* (s. l.) *telnovi* sp. nov.** (Fig. 91, plate 46 figs 23-26, map 21)

<http://zoobank.org/AF115575-6E0F-4DB5-A0D8-0208B97288A9>

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 3 km W, 00°26'04"S, 130°47'41"E, 40-



50 m, 17.II.2012, secondary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 22 specimens: 1 adult KGC: same label as holotype; 7 adults NME, 10 adults & 4 juv. KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4,5 km SW, Waiwo dive resort, 00°26'07"S, 130°46'45"E, 10-15 m, 21.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: Patronymic. This species is devoted to its first collector, famous entomologist, biogeographer and New Guinea explorer Dr. Dmitry Telnov (The Entomological Society of Latvia, Rīga).

Measurements: Holotype H = 2.7 mm, D = 1.75 mm, HW = 1.4 mm, PD = 1.3 mm. Selected paratype specimens: H = 3 mm, D = 1.9 mm, HW = 1.5 mm, PD = 1.35 mm; H = 2.95 mm, D = 1.8 mm, HW = 1.4 mm, PD = 1.4 mm; H = 2.9 mm, D = 1.75 mm, HW = 1.4 mm, PD = 1.3 mm; H = 2.9 mm, D = 1.75 mm, HW = 1.4 mm, PD = 1.35 mm; H = 2.6 mm, D = 1.7 mm, HW = 1.25 mm, PD = 1.3 mm.

Description: Shell is small, pale brown, dextral, obese with flattened apex. Shell with $5\frac{3}{4}$ convex whorls, the $1\frac{1}{2}$ embryonic whorl is microscopically pitted. The protoconch is placed oblique on the rest of the shell. The suture is deeply impressed. The ultimate whorl is constricted, slightly wider than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a broad shallow impression, much denser and delicate axial ribs and a cavity-like impression of the suture above the constriction. The constriction is more or less centered in apertural view. There is a strong bulb just beyond the constriction above the columellar side of the aperture. The teleoconch is sculptured with coarse widely-spaced inconspicuously sinuous ribs. There are abrupt changes in the ribbing pattern – the ribs becoming 3x more distant beyond the constriction. The ribs are partially synchronized with those of the previous whorls and are oblique to the coiling axis. There are 8-10 ribs per 1 mm. Spiral striae are not visible at 80x magnification. The aperture is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly double. The parietal margin of the peristome is attached to the ultimate whorl. The palatal margins of both peristomes are slightly sinuous. The inner peristome forms a continuous polished callus. The columella is smooth, provided with a very large triangular knob in its upper half. This knob is directed backwards. The operculum is derivative - circular and concave, with a single peripheral ridge on the outer surface.

Differential diagnosis: This species is distinctive primarily due to its coarse and distant axial ribs and presence of a large backward directed knob on the columella.

Ecology: This species found in secondary lowland rainforests on limestone soil about 10-50 m altitude. Specimens were collected from under of large fallen leaves.

Distribution: Raja Ampat Islands: Waigeo Island.

Conservation status: Endangered, EN B1B2ab(iii,iv). This species inhabits western peninsula of Waigeo, hitherto recorded from two localities in the southern part of it. Not enough data available to calculate current EOO. The maximum EOO estimated below 5000 km² (the area of Waigeo and adjacent islets plus available habitat). The current AOO is 8 km², but the maximum AOO estimated below 500 km² (taking into account available habitat). The population size is unknown, but this species is not uncommon locally. Habitat loss and alteration are the main threats. Rainforests are converted to gardens, timber collecting and small-scale logging take place. Growing human population of southern Waigeo and increasing tourism in the area (both national and international) demand more gardens, infrastructure and tourism resorts. Waigeo got a regency capital of Raja Ampat administrative province of Indonesia some years ago, which resulted in boosting development. Waigeo is initially rich in limestone rocks and this raw material is widely used for roads and buildings construction. Growing population (partly a result of immigration from other islands of Indonesia) requires more firewood and charcoal. Aforementioned factors result in slow decline in primary lowland rainforests cover, especially in SW part of Waigeo. This trend is observed, projected and likely to continue resulting in decline of the AOO. Specimens of *P. telnovi* sp. nov. were observed also in disturbed forests with closed canopy (wet litter is the key). Between 2001-2014 south-western Waigeo lost just about 1100 ha of the rainforest (calculated for canopy density over 25% according to the Global Forest Watch (2016)), but almost exactly in the area where *P. telnovi* sp. nov. occurs. Additional research is required on distribution of this species and its population size. It seems important to clarify if *P. telnovi* sp. nov. is distributed all over Waigeo or is limited to southern part of it.

***Palaina* (s. l.) *thomasrinteleni* sp. nov.** (Fig. 92, plate 47 figs 1-4, map 15)

<http://zoobank.org/D9484389-414E-42E0-B15D-668C37D09980>



Holotype NMNL: Coll. J.J. Vermeulen, nr. 4725 Palaina indet. - Diplommatinidae 1995.06. INDONESIA. Tanimbar Islands; W part Yamdena Isl., near Kpg. Makatian. Undisturbed primary forest on limestone, near riverbed, 4-6 km from the sea (3-5 km from a brackish river). Leg. A.J. Whitten, 00/10/1995.

Paratypes 2 adults & 1 juv. NMNL: same label as holotype [one adult is broken].

Derivatio nominis: Patronymic. This species is devoted to Dr. Thomas von Rintelen (MHUB), my good friend and famous specialist on evolution and taxonomy of the Indo-Australian freshwater gastropods.

Measurements: Holotype H = 3.3 mm, D = 1.8 mm, HW = 1.6 mm, PD = 1.3 mm. Paratype specimens: H = 3.2 mm, D = 1.9 mm, HW = 1.6 mm, PD = 1.4 mm; H = 3 mm, D = 1.8 mm, HW = 1.5 mm, PD = 1.05 mm.

Description: Shell is large, creamy coloured, dextral, conical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined by presence of a very shallow impression and denser and lower pattern of axial ribs. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate low and very widely-spaced ribs. The ribs are slightly elevated and strongly J-like bent at the periphery of each whorl and therefore form low, lamella-like protrudings (in juvenile shells the ribs are developed into long spine-like folded protrudings (Plate 47 fig. 4)). They fall off when the shell is growing and only low basements remain visible on adult shells (Plate 47, figs 1-3)). The ribs are incomplete on most of the teleoconch (Plate 47, figs 1-3). The ribs are only complete (upper parts of the ribs is present) on the last half whorl where they becoming lower and less strongly bend. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 3 bent ribs per 1 mm. Rather dense axial striation is present between the ribs. At the constriction the ribs are straight (not bend) and dense. Spiral striae are lacking. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, very thin in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The inner peristome forms a narrow continuous polished callus. The pa-

rietal and the columellar margins of the outer peristome are sinuous. The columella is very broad. Operculum is unknown.

Differential diagnosis: This species is distinctive among all other congeners due to the combination of the following characters: shell dextral with peculiar very widely-spaced J-like bent axial ribs. Its sympatric congener *P. tanimbarensis* sp. nov. (Yamdena Island; see description of this species above) is different in sinistral broadly cylindrical shell and the higher, c-like bent axial ribs.

Ecology: Specimens found in primary riverine lowland rainforest on limestone soil.

Distribution: Tanimbar Islands: Yamdena Island.

Conservation status: Data Deficient, DD. This species is known from small series of individuals. Its habitat, population size and threats are unknown. Further basic research is required.

***Palaina* (s. l.) *vermeuleni* sp. nov.** (Fig. 93, plate 47 figs 5-7, map 15)

<http://zoobank.org/0800C397-F08F-4316-966A-5CFB3920DAA1>

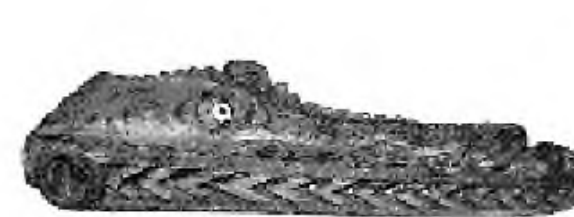
Holotype NMNL: Coll. J.J. Vermeulen, nr. 4170 Arinia dohertyi (E.A. Smith 1897) Diplommatinidae INDONESIA. Aru Islands, Pulau Kobroor, near Jerlai. Dry river bed over limestone soil. Leg. M. v. Balgooij, 29/04/1993.

Paratypes 2 adults NMNL: same label as holotype [one adult is badly broken].

Derivatio nominis: Patronymic. This species is devoted to Dr. Jaap Jan Vermeulen (NMNL), an authority in Oriental terrestrial molluscs who provided me with this new material.

Measurements: Holotype H = 3.9 mm, D = 2.3 mm, HW = 2.3 mm, PD = 1.9 mm. Selected paratype specimen H = 3.7 mm, D = 2.4 mm, HW = 2.1 mm, PD = 1.7 mm.

Description: Shell is large, whitish to creamy coloured, dextral, cylindrical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is deeply impressed. There is a rather strong bulb just beyond the constriction above the columellar side of the aperture. The ultimate whorl is slightly constricted, hardly narrower than the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is well defined by presence of a broad flat impression, a zone of more distant axial ribs and a cavity-like impression on the suture above the constriction. The constriction is more or less centered in apertural view. The teleoconch is sculptured with delicate dense straight ribs. There are abrupt changes in the ribbing pattern – the ribs becoming



very inconspicuous, almost disappear at the constriction area, but beyond the constriction reappear again and becoming coarser and 3-4x sparser than on the previous whorl. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are about 17-20 ribs per 1 mm. Spiral striae are lacking. The aperture is not tilted to the coiling axis, is oval and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is simple, developed in a very broad continuous callus. Numerous very dense lamellae on the ultimate whorl prior to the peristome. The parietal side of the peristome is pressed against the parietal wall. The margins of the peristome are not or slightly sinuous. The columella is simple, with an obtuse median angulation. Operculum is unknown. Differential diagnosis: This species belongs to a group of *Palaina* with a distinct bulb on the ultimate whorl just beyond the constriction. Compared with similar congeners, *P. vermeuleni* sp. nov. has an ordinary peristome (the peristome is very thick in lateral view in *P. polystoma* B. Rensch, 1931 and in *P. chrysostoma* E.A. Smith, 1897, both from Flores Island). The aperture is without columellar callus and there is no knob on columella in *P. vermeuleni* sp. nov. (flat but distinct basal knob present in *P. chrysostoma*). There are about 17-20 ribs per 1 mm on the penultimate whorl in *P. vermeuleni* sp. nov., its shell is stronger conical (in *P. novoguineensis* E.A. Smith, 1897 from W New Guinea and Misool, shell is more obese and there are about 10-13 ribs per 1 mm on the penultimate whorl). Generally, more material is necessary to highlight another differences between *P. vermeuleni* sp. nov. and *P. novoguineensis*.

Ecology: Specimens found in riverine lowland rainforest on limestone soil.

Distribution: Aru Islands: Kobroor Island.

Conservation status: Data Deficient, DD. This species is known from the small series of individuals. Its habitat, population size and threats are unknown. Further basic research is required.

***Palaina* (s. l.) *waigeo* sp. nov.** (Figs 94-95, 103 & 143, plate 47 figs 8-13, map 21)

<http://zoobank.org/6E047643-16FF-4F8D-9137-5F01C5DA3137>

Holotype NME: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 3 km W, 00°26'04"S, 130°47'41"E, 40-50 m, 17.II.2012, secondary lowland rainforest on limestone, leg. D.Telnov.

Paratypes 3 specimens: 1 adult KGC: same label as holotype; 1 adult KGC: INDONESIA E, Raja Ampat Prov., Wayag Island, along the southern coast, 31.X.2011,

leaf debris in forest at the foot of limestone cliff, leg. L.Wagner; 1 adult KGC: INDONESIA E, Raja Ampat, Waigeo Island, Waisai 4,5 km SW, Waiwo dive resort, 00°26'07"S, 130°46'45"E, 10-15 m, 21.II.2012, primary lowland rainforest on limestone, leg. D.Telnov.

Derivatio nominis: This species is named after Waigeo Island, its main area of occurrence. Noun in apposition, invariable.

Measurements: Holotype H = 1.3 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.55 mm. Paratype specimens from Waigeo: H = 1.35 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.5 mm; H = 1.3 mm, D = 0.7 mm, HW = 0.7 mm, PD = 0.5 mm.

Description: Shell is very small, yellowish, sinistral, cylindrical with flattened apex. Shell with 5½ convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is constricted, nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. Suture is slightly impressed above the constriction (additionally, in one paratype the constriction area is free of axial ribs). The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with dense delicate straight (in paratypes) or sinuous (in holotype) axial ribs. There are abrupt changes in the ribbing pattern - starting from the constriction the ribs becoming coarser and twice more distant. The ribs are not synchronized with those of the previous whorls and are slightly oblique to the coiling axis. There are about 17-19 ribs per 0.5 mm. Spiral striae are extremely delicate and dense, poorly indicated at 80x magnification (5-6 rows of spiral striae per 30 µm measured on the ultimate whorl above the aperture). The aperture is not tilted against the coiling axis, is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is distinctly double. Few inconspicuous flat lamellae present between the peristomes in lateral view. The outer peristome is stronger than the inner one. The parietal margin of the peristome is attached to the ultimate whorl. Peristomal margins are not sinuous or the outer peristome is slightly sinuous palatally. The inner peristome forms a continuous polished callus. The outer peristome is broadly discontinued parietally, somewhat reflexed. The columella is rather broad and smooth. The operculum is primitive - circular and without concentric lines of ridges.

Differential diagnosis: This species is similar to several minute Papuan *Palaina* species (consider characters discussed in table 17, see next page).



Ecology: This species occurs in secondary and, supposedly, also in primary lowland rainforests on limestone soils.

Distribution: Raja Ampat Islands: Waigeo Island, Wayag Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO. The current AOO is 12 km² but the maximum AOO is likely much higher. *Palaina waigeo* sp. nov. is known from three localities; all localities are not far from the seashore. Threats for this species are unknown. Waigeo Island as well as Wayag are still

very pristine and covered by primary rainforests for over 75%, but local development is ongoing exactly in coastal areas where this species was found (e.g. road construction; Waisai new airport located ~3-4.5 km from two of *P. waigeo* sp. nov. localities). Further research is required on distribution of this species as well as on its population size and threats.

Table 17. Papuan species of *Palaina* s. l. similar to *P. waigeo* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. waigeo</i> sp. nov.
<i>Palaina albrechti</i> sp. nov.	axial ribbing pattern changes evenly starting from the constriction	there are abrupt changes in the axial ribbing pattern - starting from the constriction ribs becoming coarser and 2x more distant
<i>P. biroi</i>	the operculum with low concentric ridges and shallow median impression on the outer surface	the operculum without concentric ridges and without median impression
<i>Palaina flavocylindrica</i> sp. nov.	9-10 rows of spiral striae per 30 µm (measured above the aperture), H = 1.55-1.7 mm	5-6 rows of spiral striae per 30 µm (measured above the aperture), H = 1.3 mm
<i>P. iha</i> sp. nov.	axial ribbing pattern changes evenly starting from the constriction	there are abrupt changes in the axial ribbing pattern - starting from the constriction ribs becoming coarser and 2x more distant
<i>P. insulana</i> sp. nov.	H = 1.8-1.95 mm, the peristome rather broad (in lateral view) and consists of numerous dense lamellae, the outer peristome not or slightly stronger than inner one	H = 1.3 mm, few flat lamellae between the inner and the outer peristomes, the peristome not broad (in lateral view), the outer peristome is stronger than the inner one
<i>P. lengguru</i> sp. nov.	shell generally lower, W = 4¾-5, axial ribs more widely-spaced and more oblique to the coiling axis, the outer peristome is less strongly expanding, the columella widening basally	shell generally higher, W = 5½, axial ribs denser and slightly oblique to the coiling axis, the outer peristome is comparatively stronger expanding, the columella not widening basally
<i>P. minuscularia</i> sp. nov.	about 25-28 ribs per 0.5 mm, the columella with basal knob, 4 rows of spiral striae per 30 µm (measured above the aperture)	about 17-20 ribs per 0.5 mm, the columella is simple, 5-6 rows of spiral striae per 30 µm (measured above the aperture)

***Palaina* (s. l.) *wawiyai* sp. nov.** (Figs 96 & 116, plate 47 figs 17-19, map 20)
<http://zoobank.org/D124B936-196E-4831-B439-A6F45104EA05>
Holotype LKCNHM: Indonesia: West Papua [sic!], Waigeo, Lopintol, Gua Kalepale, Leg. T. Whitten, Jan 2013.
Paratypes 23 LKCNHM & 3 KGC: same label as holotype [2 paratypic shells are broken].

Derivatio nominis: Named after Wawiyai, local tribe in Lopintol, the area where this species was first collected. Noun in apposition, invariable.

Measurements: Holotype H = 3.6 mm, D = 2.15

mm, HW = 1.8 mm, PD = 1.8 mm. Selected paratypic specimens: H = 3.3 mm, D = 2.1 mm, HW = 2 mm, PD = 1.8 mm; H = 3.2 mm, D = 2.2 mm, HW = 2 mm, PD = 1.9 mm; H = 3.1 mm, D = 2.2 mm, HW = 1.9 mm, PD = 1.7 mm.

Description: Shell is large, yellowish, sinistral, cylindrical with conical apex. Shell with 6 convex whorls, the 1½ embryonic whorl is microscopically pitted. The suture is rather deeply impressed. The ultimate whorl is strongly constricted, ascending, it is nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The protoconch is placed oblique on the rest of the



shell. There is a deep sutural impression above the constriction. The constriction situated on same axis with the columellar side of the aperture. There is an inconspicuous bulb just beyond the constriction (the bulb can be completely hidden under strongly expanded peristome). The teleoconch is sculptured with coarse widely-spaced straight axial ribs. There are abrupt changes in the ribbing pattern – the ribs becoming less coarse and twice denser on the last two whorls. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 9-11 ribs per 1 mm. Spiral striae are lacking at x500 magnification, but very inconspicuous axial striation (growth lines?) present between the axial ribs. The aperture is not or slightly tilted to the coiling axis, is strongly ovoid and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, thick in lateral view. Very dense flat lamellae developed between the inner and the outer peristome. The parietal margin of the peristome is detached from the ultimate whorl (in specimens with particularly strongly developed peristome - from the penultimate whorl). The inner peristome forms a very broad continuous polished callus completely covering the penultimate whorl and (in certain specimens) also covering a part of the penultimate whorl. Two very distinct obtuse ear-like protrudings near the palatal / parietal and the parietal / columellar junctions (Plate 47 figs 17 & 19). The palatal and the columellar margins of both peristomes are strongly sinuous. The outer peristome is broadly discontinued parietally. The columella is smooth and very broad, strongly narrows in basal third. Operculum is unknown.

Differential diagnosis: This species is similar to *P. laszloi* sp. nov. (Wayag Island NW of Waigeo), but differs primarily in stronger expanded peristome, ovoid aperture (aperture is circular in *P. laszloi* sp. nov.), dense and quite delicate axial ribbing pattern of the ultimate whorl (the ribs are distant and coarse on the ultimate whorl in *P. laszloi* sp. nov.) and different columella (the median knob is present on the columella in *P. laszloi* sp. nov.). *P. laszloi* sp. nov. is also generally smaller than *P. wawiyai* sp. nov.

Ecology: Unknown.

Distribution: Raja Ampat Islands: Waigeo Island. Co-ordinates of Gua [cave] Kalepale are 00°17'18"S, 130°49'15"E, but no information is available where exactly these specimens were sampled.

Conservation status: Data Deficient, DD. This species is known from specimens collected under

unknown circumstances and habitat of this species is unknown. Not enough data available to calculate current EOO. The maximum EOO estimated no less than 65 km² taking into account Lopintol area of West Waigeo. The current AOO is 4 km², the maximum AOO is certainly under 500 km². The population size and trend are unknown. Threats to this species are unknown. Further basic research is required.

***Palaina* (s. l.) *wisemani* (Cox, 1870)** (Plate 47 figs 20-24, map 11)

Additional material: 1 adult MCZ: Mus.Comp.Zoöl., Cambridge, Mass. No. [printed] 188093 *Palaina wisemani* Cox Kira Kira, San Cristoval Solomon Ido. [sic!] Dec. 1929 Whitney Exp. [handwritten] Ex. A.M.N.H. Acc. 503 [printed]; 1 adult MCZ: Mus.Comp.Zoöl., Cambridge, Mass. No. [printed] 188094 *Palaina wisemani* Cox Santa Ana Id., Solomon Ido. [sic!] Dec. 1929 Whitney Exp. [handwritten] Ex. A.M.N.H. Acc. 503 [printed].

Note: Type specimens of this species (at the Linnean Society of New South Wales) were lost in the great fire at the Garden Palace in September of 1882 (Jude Philp, personal communication). Redescription is based on MCZ specimens from Kira Kira, Makira (= San Cristobal) Island.

References: Cox (1870: 84), as *Diplommatina wisemani*; Pfeiffer (1876: 84), as *D.[iplommatina] Wisemani*; Kobelt & von Möllendorff (1898: 152), checklist, as *Palaina* Subgen. *Palaina* s. str. *wisemani*; Kobelt (1902: 406), as *P. (P.[alaina]) wisemani*; Solem (1960: 49); Gardner (1990: 7).

Measurements: Selected specimen from MCZ: H = 2.4 mm, D = 1.1 mm, HW = 1.1 mm, PD = 0.9 mm (Gardner (1990) gave the following measurements for Kira Kira specimen: H = 1 mm, D = 0.5 mm what is definitively wrong for *P. wisemani*).

Description: Shell is very small, yellowish or pale brown, sinistral, conical with conical apex. Shell with 5¾ convex whorl, there is 1½ embryonic whorl. The suture is moderately deeply impressed. The ultimate whorl is constricted and slightly ascending, it is slightly narrower than the penultimate whorl in apertural view. The constriction is poorly defined by a shallow impression, is more or less centered in apertural view. The teleoconch is sculptured with coarse widely-spaced straight or slightly sinuous axial ribs. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are oblique to the coiling axis. There are 6 ribs per 0.5 mm. Spiral striae are lacking. The aperture is not tilted with regard to the coiling axis and is circular and has entire apertural rim. The aperture is more or less



centered below the penultimate whorl in apertural view. The peristome is simple, with a broad zone of numerous delicate lamellae prior to the peristome in lateral view. The peristome forms a very broad continuous polished callus, expands and covers over a half of the ultimate whorl in apertural view. Peristomal margins are not sinuous. The parietal margin of the peristome is not completely attached to the ultimate whorl. No specimens were available to study the internal lamellae. Operculum is unknown.

Ecology: According to the original description, this species was found on wet places in montane areas. Gardner (1990) signals specimens from leaf litter at rainforest edge. Makira Island was initially covered by primary lowland rainforest.

Distribution: Solomon Islands: Makira (= San Cristobal) Island, Owaraha (= Santa Ana) Island.

Conservation status: Data Deficient, DD. Not enough data available to calculate current EOO and AOO. The maximum EOO estimated at least 4000 km² taking into account the area of Makira and adjacent islets. The maximum AOO cannot be calculated. The population size and trend are unknown. Further basic research is required to highlight status of this species in the wild, clarify its distribution, measure the population size and uncover threats.

***Palaina* (s. l.) *yamdena* sp. nov.** (Figs 97, 144-145, plate 43 figs 25-27, map 15)

<http://zoobank.org/61FEF1D5-FA43-4FF7-A97B-352AA457E2C2>

Holotype NMNL: Coll. J.J. Vermeulen, nr. 4726 Palaina indet. - Diplommatinidae 1995.06. INDONESIA. Tanimbar Islands; W part Yamdena Isl., near Kpg. Makatian. Undisturbed primary forest on limestone, near riverbed, 4-6 km from the sea (3-5 km from a brackish river). Leg. A.J. Whitten, 00/10/1995.

Paratypes: 7 adults NMNL: same label as holotype; 2 adults LKCNHM: ZRC.1999.2449 [handwritten] / Coll. J.J. Vermeulen, nr. 4726 Arinia - [printed] ZRC.199.2449 [handwritten] Diplommatinidae [printed] 2nos [handwritten] INDONESIA, Tanimbar Group, W part Yamdena Isl., nr Kpg Makatian. Undisturbed primary fst on limestone, nr riverbed, 100-150 m asl, 4-6 km from the sea (3-5 km from a brackish river. Leg. A.J. Whitten, 10/1995. [printed] / ZOOLOGICAL REFERENCE COLLECTION DEPARTMENT OF ZOOLOGY NATIONAL UNIVERSITY OF SINGAPORE [printed] Diplommatinidae ZRC.MOL.10459 Ex [handwritten] ZRC. [printed] 199.2449 [handwritten] No. Spec. [printed] 2 nos. [handwritten] Species. [printed] Arinia [handwritten] Locality [printed] Indonesia, Tanimbar Group, W. part Yamdena Island, nr. Kampong Makatian. [handwritten] Collector [printed] A.J. Whitten Date [printed] Oct. 1995 [handwritten] Det. by [printed] JJ Vermeulen, nr. 4726 [handwritten] Date [printed].

Derivatio nominis: Toponymic. This species is named after Yamdena Island where it occurs and with regard to the main local language of this island. Noun in apposition, invariable.

Measurements: Holotype H = 1.8 mm, D = 1 mm, HW = 0.95 mm, PD = 0.7 mm. Selected paratypic specimens: H = 2 mm, D = 1.05 mm, HW = 0.8 mm, PD = 0.8 mm; H = 1.85 mm, D = 1 mm, HW = 1.05 mm, PD = 0.7 mm; H = 1.85 mm, D = 0.95 mm, HW = 0.95 mm, PD = 0.7 mm.

Description: Shell is small, whitish on upper and yellowish on lower whorls, sinistral, cylindrical with conical apex. Shell with 5¼ convex whorls, the 1¼ embryonic whorl is microscopically pitted. The suture is deeply impressed. The ultimate whorl is constricted, nearly as wide as the penultimate whorl in apertural view. The umbilicus is closed in adult. The constriction is poorly defined since the suture is slightly impressed above it and a very shallow shell wall impression is present at the constriction. The constriction situated on same axis with the columellar side of the aperture. The teleoconch is sculptured with delicate rather dense straight ribs. The ribs becoming slightly more distant on the last half whorl. There are no abrupt changes in the ribbing pattern. The ribs are not synchronized with those of the previous whorls and are slightly oblique with regard to the coiling axis. There are about 8-10 ribs per 0.5 mm. Spiral striae are extremely delicate and dense. The aperture is not tilted to the coiling axis and is circular and has entire apertural rim. The aperture is more or less centered below the penultimate whorl in apertural view. The peristome is double, consists of a few strong lamellae in lateral view. The parietal margin of the peristome is attached to the ultimate whorl. The outer peristome is broadly discontinued parietally. Peristomal margins are not sinuous. The columella is straight and shiny. Operculum is unknown.

Differential diagnosis: *Palaina yamdena* sp. nov. is conchologically similar with several Papuan species, but is specifically different (see Table 18; next page).

Ecology: Specimens found in primary riverine lowland rainforest on limestone soil.

Distribution: Tanimbar Islands: Yamdena Island. **Conservation status:** Data Deficient, DD. Not enough data available to calculate current EOO and AOO. This species is known from single locality. Its population size, trend and threats are unknown. Further basic research is required.

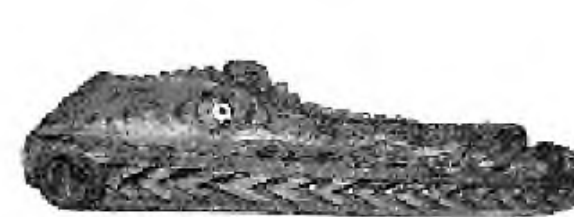


Table 18. Papuan species of *Palaina* s. l. similar to *P. yamdena* sp. nov. and their distinctive characters.

Species	Character	Character in <i>P. yamdena</i> sp. nov.
<i>Palaina adelpha</i>	axial ribs coarse, becoming coarser & higher, more distant on the ultimate whorl	axial ribs delicate, not becoming conspicuously coarser or distant on the ultimate whorl
<i>P. albrechti</i> sp. nov.	shell apex flattened, shell regularly cylindrical	shell apex conical, shell not regularly cylindrical
<i>P. angulata</i>	shell prevalently dextral (sinistral specimens known), H = 2.3 - 2.8 mm, the columella is broad with glass-like inner edge	shell sinistral. H = 1.8 - 2 mm, the columella is thin and not glass-like
<i>P. biroi</i>	shell cylindrical, axial ribs sinuous, becoming coarser & more distant toward the end of tuba, shell regularly cylindrical	shell either conical, axial ribs either straight, not becoming conspicuously coarser or distant on tuba, shell not regularly cylindrical
<i>P. carbavica</i>	the columella with a large median triangular basal knob, shell dextral	the columella is simple and thin, shell sinistral
<i>P. citrinella</i>	H = 3.5 mm, axial ribs high and lamella-like	H under 2.5 mm, axial ribs low & delicate
<i>P. doberai</i> sp. nov.	the columella with a large median triangular basal knob, the peristome is very thick in lateral view	the columella is simple and thin, the peristome is thin in lateral view
<i>P. flavocylindrica</i> sp. nov.	axial ribs becoming coarser & more distant toward the end tuba, 16-18 ribs per 0.5 mm on the penultimate whorl	axial ribs not becoming conspicuously coarser or distant on tuba, 8-10 ribs per 0.5 mm on the penultimate whorl
<i>P. hartmanni</i> sp. nov.	axial ribs very coarse and widely-spaced toward the end of tuba, the palatal margin of the inner peristome is strongly sinuous	axial ribs not conspicuously coarser or distant on tuba, the palatal margin of the inner peristome is not sinuous
<i>P. insulana</i> sp. nov.	axial ribs becoming coarser & more widely-spaced toward the end of tuba, ribs are denser on early teleoconch whorls than on the last two whorls, shell is cylindrical	axial ribs not becoming conspicuously coarser or distant on tuba, ribs more or less equally dense on all the teleoconch whorls, shell is conical
<i>P. lengguru</i> sp. nov.	axial ribs becoming coarser & more distant toward the end of tuba, 13-15 ribs per 0.5 mm on the penultimate whorl, H = 1.4 mm, shell is cylindrical	axial ribs not becoming conspicuously coarser or distant on tuba, 8-10 ribs per 0.5 mm on the penultimate whorl, H = 1.8 - 2 mm, shell is conical
<i>P. louisjade</i> sp. nov.	axial ribs becoming 2.5x more widely-spaced on tuba, shell about 1.8-2x higher than broad	axial ribs becoming maximum 2x more widely-spaced on tuba, shell is less slender
<i>P. psittricha</i> sp. nov.	axial ribs becoming coarser & more distant toward the end of tuba, the aperture is not centered to the coiling axis, the ultimate whorl is narrower than the previous in apertural view	axial ribs not becoming conspicuously coarser or distant on tuba, the aperture is centered to the coiling axis, the ultimate whorl nearly as wide as the previous in apertural view

Identification keys to the Papuan and Wallacean Diplommatinidae (Sulawesi excluded)

The original identification keys below are based only on conchological characters. In most cases comparative material is essential for proper identification of species. There are many species still awaiting description. The present keys are only valid for species described and depicted in this publication.

Key to *Diancta*

- 1 The aperture is more or less distinctly shifted left against the coiling axis in apertural view. Less than 12 axial ribs per 1 mm on the penultimate whorl in apertural view 2
- In apertural view the position of the aperture is either central (Plate 19 fig. 11). About 13 axial ribs per 1 mm on the penultimate whorl in apertural view
..... *D. multiplicata*
2 Penultimate whorl with upper and lower margins parallel or almost parallel in apertural view, only one whorl is strongly bulbous 3
- Penultimate whorl with upper and lower margin not parallel (divergent) in apertural view, the 5th & the 6th whorls are slightly bulbous in apertural view
..... *D. halmaherica* sp. nov.



3 Internal lamellae apparatus consists of four distinct palatalis *D. torta*
– Internal lamellae apparatus consists of a single distinct palatalis *D. obiensis* sp. nov.
– Internal lamellae apparatus without distinct palatalis *D. constricta*

Key to *Diplommatina*

1 Shell sinistral 2
– Shell dextral 8
2 Shell high conical, first 4-5 whorls widen evenly 3
– Shell obese conical, first 4-5 whorls widen rapidly ... 4
3 W = 6, longitudinal palatalis is rather short
..... *D. maibrat* sp. nov.
– W = 7, longitudinal palatalis is long
..... *D. waigeoensis* sp. nov.
4 Palatal margin of the inner peristome is sinuous 5
– Palatal margin of the inner peristome is not sinuous (Plate 25 fig. 8) *D. smithi*
5 The outer peristome is angulate, expands beyond the inner one (Plate 23, figs 20 & 22) 6
– The outer peristome is circular, not or slightly expanding beyond the inner one, internal lamellae without palatalis *D. javana*
6 Columellar denticle conspicuous, directed downwards 7
– Columellar denticle inconspicuous, not directed downwards (Plate 23 fig. 20) *D. lombockensis*
7 Internal lamellae apparatus with one short transverse palatalis, no longitudinal palatalis present
..... *D. jonabletti* sp. nov.
– Internal lamellae apparatus with one longitudinal palatalis, no transverse palatalis present *D. floresiana*
8 Axial ribs lamella-like widened at the periphery of the teleoconch whorls 9
– Axial ribs lower, not lamella-like 10
9 Axial ribs high and strongly waved, complete (not shortened) and not becoming very flat on the upper part of the teleoconch whorls, the palatalis is long
..... *D. slapcinskyi* sp. nov.
– Axial ribs less conspicuous, not waved but humped at peripheries of the teleoconch whorls, becoming flat and (almost) disappear on the upper part of the teleoconch whorls, the palatalis is shorter *D. patani* sp. nov.
10 Shell is conical 11
– Shell either fusiform or cylindrical (for all decollate species use this alternative) 14
11 Shell is smaller and slender, shell H ~2.5 mm, aperture is less large, peristome is comparatively thick in lateral view, spiral striae are distinct and dense at 80x magnification 12
– Shell H ~3.4-4.2 mm, aperture is large, peristome is comparatively thin in lateral view, spiral striae generally more delicate 13

12 Internal lamellae apparatus with one transverse and one longitudinal palatalis, axial ribs are straight and regular, shell generally less high, about 12 ribs per 0.5 mm on the apertural side of the penultimate whorl
..... *D. baliana*
– Internal lamellae apparatus without transverse palatalis, axial ribs are irregular and sinuous, shell generally higher and slender, about 5-6 ribs per 0.5 mm on the apertural side of the penultimate whorl .. *D. radiiformis*
13 About 5-6 axial ribs per 1 mm on the apertural side of the penultimate whorl, 5 rows of spiral striae per 50 µm (measured on the ultimate whorl above the aperture) (Fig. 136), peristome is very thin in lateral view, indistinctly double (Plate 26 fig. 3) *D. symmetrica*
– About 8-10 axial ribs per 1 mm on the apertural side of the penultimate whorl, 5 rows of spiral striae per 50 µm (measured on the ultimate whorl above the aperture) (Figs 132-135), peristome is very thin in lateral view but clearly double with both the inner and outer peristome almost equally developed (Plate 26 figs 8, 11 & 14)
..... *D. telnovi* sp. nov.
– About 10-11 axial ribs per 1 mm on the penultimate whorl in apertural view, 3 rows of spiral striae per 50 µm (measured on the ultimate whorl above the aperture) (Figs 129-131), peristome looks simple in lateral view since the inner peristome is stronger developed and partly covers the outer peristome (Plate 24 fig. 20)
..... *D. mertonii*
14 Umbilicus is closed in adult 15
– Umbilicus is narrowly open in adult
..... *D. timorensis* sp. nov.
15 Columellar denticle is moderately long or small and short 16
– Columellar denticle is very long and prominent, directed downwards *D. moluccensis* sp. nov.
16 Whorls are strongly globose with very deep suture therefore shell outline is wavy 19
– Whorls are rather flat or slightly convex, suture is moderately deep, shell outline not wavy 17
17 Shell narrow and slender 18
– Shell more obese *D. leucopsis*
18 The palatal margin of the outer peristome is sinuous
..... *D. decollata*
– The palatal margin of the outer peristome not or slightly sinuous *D. floris*
19 About 5 ribs per 0.5 mm on the apertural side of the penultimate whorl, parietal margins of the peristome not or hardly sinuous 20
– About 4 ribs per 0.5 mm on the apertural side of the penultimate whorl, parietal margins of both the inner and outer peristomes sinuous *D. torquilla*
20 Aperture is circular, axial ribs are rather strong and high, aperture is tilted about 10-15° to the coiling axis
..... *D. lucifuga*
– Aperture with straight columellar side and angulate basal / columellar junction of the outer peristome, axial ribs moderately strong, aperture is not tilted to the coiling axis *D. fluminis*



Key to ***Moussonia***

- 1 Shell with strong peristomal rim reinforced by labial callus 2
 – Peristomal rim not present 8
 2 Shell dextral, conical 3
 – Shell sinistroid, cylindrical (up to five early whorls are dextral, shell coiling direction reverses to sinistral from the 5th whorl, 5 early whorls are completely overgrown by the tuba) *M. monstificabilis* sp. nov.
 3 Shell broadly conical 4
 – Shell slender, either high conical 5
 4 Parietalis Y-like, merged from two parietal lamellae columella with more or less horizontal knob
 *M. separanda* sp. nov.
 – Parietalis simple, knob of the columella is directed upwards *M. pseudoseparanda* sp. nov.
 5 Axial ribs very delicate and poorly indicated, shell surface looks smooth or finely axially striate at 80x magnification *M. torricelli* sp. nov.
 – Axial ribs more conspicuous 6
 6 Shell H ~1 mm, axial ribs very widely-spaced
 *M. hyponepia*
 – Shell H over 1.8 mm, axial ribs are dense 7
 7 Shell H 2.5-2.9 mm, shell more obese, the peripheral carina poorly defined *M. omias*
 – Shell H up to 2.2 mm, shell slender, the peripheral carina stronger developed *M. papuana*
 8 The inner peristome discontinued at the insertion of the columellar denticle, shell less high 9
 – The inner peristome continuous, shell high and slender *M. athena*
 9 Rectangular sculpture not present on the teleoconch or is not prominent 10
 – Shell sculpture with rather prominent irregularly rectangular cells between spiral and axial sculpture
 *M. manuselae* sp. nov.
 10 W = 8, shell H over 2.5 mm, rectangular sculpture less prominent on shell 11
 – W = 7, shell H under 2.5 mm, shell with prominent rectangular sculpture (Plate 28 figs 4 & 6)
 *M. manuselae* sp. nov.
 11 Shell H about 3.5 mm, shell comparatively wider with smaller aperture (Plate 27 fig. 17) *M. hirsuta*
 – Shell H about 2.7 mm, shell comparatively slender with larger aperture (Plate 28 fig. 14) *M. strubelli*

Key to ***Arinia*** and ***Palaina***

Since delimitation between *Arinia* and *Palaina* remains unclear (see diagnoses of both genera above), the present key is valid for both groups from the study area.

- 1 Shell dextral (*Palaina angulata* is assessed in both branches) 2
 – Shell sinistral (*Palaina angulata* is assessed in both

- branches) 23
 2 The umbilicus is narrowly open in adult, the operculum with median tubular process on the outer surface
 *A. talautana*
 – Umbilicus is closed in adult 3
 3 No axial ribs on last two whorls at 80x magnification, shell is smooth or with inconspicuous axial striation (early whorls with very widely-spaced axial ribs) 4
 – Axial ribs more or less prominent even when very widely-spaced, well indicated at 80x or smaller magnification 5
 4 Shell obese and large, H ~4 mm *A. crassiventris*
 – Shell slender cylindrical and small, H ~1.8-2.1 mm ...
 *A. tjendanae*
 5 Axial ribs are dense or moderately distant, not J-like bent at the peripheries of the teleoconch whorls and not developed into lamella-like protrudings 6
 – Axial ribs are very widely-spaced and strongly J-like bent at the peripheries of the teleoconch whorls in a form of low protrudings (Plate 47 figs 1-3), in juvenile shells ribs develop into spine-like folded protrudings (Plate 47 fig. 4) *P. thomasrinteleni* sp. nov.
 6 Shell is very small, H ~1.3-1.4 mm, axial ribs widely-spaced, peristome is strongly double without lamellae between the equally strong inner and outer peristomes
 *P. minutula* sp. nov.
 – Shell H 1.8 mm or larger, margins of the peristome are less strong, several lamellae present in lateral view between the inner and the outer peristomes 7
 7 Shell with a strong (large and distinctly angulate) bulb beyond the constriction (visible in apertural view) 8
 – When present, bulb is inconspicuous (flat) 13
 8 The penultimate whorl not bulbous, not or slightly wider than the penultimate whorl in apertural view 9
 – The penultimate whorl bulbous, wider than the penultimate whorl in apertural view *P. dianctoides* sp. nov.
 9 Columella without backwards directed knob 10
 – Columella with a large backwards directed knob
 *P. telnovi*
 10 Peristome is ordinary, not very broad in lateral view 12
 – Peristome is conspicuously broad in lateral view 11
 11 H~5-6 mm, columella with flat but distinct basal knob, parietal callus present in the aperture
 *P. chrysostoma*
 H ~3-4 mm, columella with inconspicuous semitransparent basal knob, columellar callus present in the aperture in certain specimens *P. polystoma*
 12 Axial ribs generally denser, about 17-20 ribs per 1 mm on the penultimate whorl in apertural view, shell more conical, less obese, axial ribs almost disappear at the constriction, bulb is weak *P. vermeuleni* sp. nov.
 – Axial ribs generally less dense, about 10-13 ribs per 1 mm on the penultimate whorl in apertural view, shell comparatively more obese, axial ribs becoming denser and more delicate but not disappear at the constriction, bulb is stronger *P. novoguineensis*
 13 Shell distinctly conical, teleoconch whorls widen evenly 14



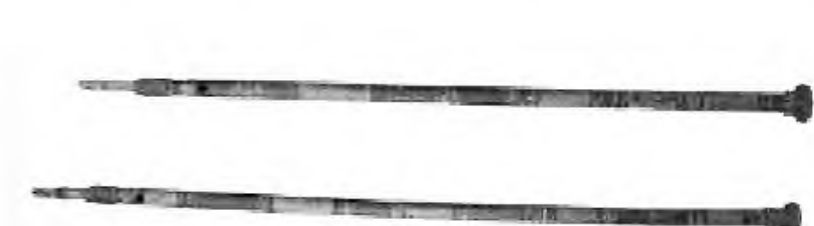
- Shell either obese conical or cylindrical with conical or flattened apex (only few early whorls are conical), teleoconch whorls widen rapidly 16
- 14 Peristome is thick in lateral view, consists of numerous lamellae between the inner and the outer peristomes 15
- Peristome is thin in lateral view, no or few flat lamellae between the stronger developed inner and outer peristomes *P. brazieri*
- 15 Shell is large to very large, H ~4.3-5.2 mm, the palatal margin of the peristome is straight, peristome is moderately thick in lateral view *P. gardneri*
- Shell is small, H ~3 mm, the palatal margin of the peristome is strongly sinuous, peristome is very thick in lateral view *P. solomonensis*
- 16 Shell obese or cylindrical, aperture more or less centered below the penultimate whorl in apertural view, the constriction poorly defined on shell wall 17
- Shell shape high cylindrical, aperture shifted right against the coiling axis in apertural view, the constriction is defined by a distinct impression .. *P. diepenheimi*
- 17 The outer peristome is not or partly expanding beyond the inner one, not encircling the aperture and not extraordinary broad 18
- The outer peristome expands strongly beyond the inner one, encircles the aperture and is broadly discontinued parietally *A. patagiata*
- 18 Columella with a large backwards directed knob .. 19
- Columella without knob 20
- 19 Shell is large and very obese, H ~3.6-3.8 mm, tuba and aperture are strongly ascending *P. ascendens*
- Shell is small and slender cylindrical, H ~1.8-2 mm, tuba and aperture are not ascending *P. carbavica*
- 20 Shell is small, cylindrical or fusiform, H ~2.05-3 mm, no bulb present 21
- Shell is large, H ~3-4 mm, obese, an inconspicuous bulb beyond the constriction *P. mairasi* sp. nov.
- 21 Shell cylindrical with short apex (e.g. plate 30 figs 11-13, plate 40 figs 1-9) 22
- Shell with conical apex (Plate 32 figs 1-2, 4-9), the operculum with concentric ridges, W = 5¼–5½ *P. angulata*
- 22 The outer peristome stronger than the inner one, the inner peristome situated distant from the outer one in lateral view *P. manggaraica*
- The outer peristome not stronger than the inner one, the inner peristome situated close to the outer one in lateral view *A. blanda*
- 23 The umbilicus is open in adult 24
- The umbilicus is very narrowly open in adult *P. slapcinskyi* sp. nov.
- The umbilicus is closed in adult 27
- 24 Shell obese 25
- Shell distinctly conical, the umbilicus is broadly open *P. perspectiva* sp. nov.
- Shell high cylindrical, the umbilicus less broadly open *P. mutis* sp. nov.
- 25 The umbilicus distinct but rather narrow, the tuba is not or slightly ascending, shell is small or large 26
- The umbilicus is broadly open, shell is large, H ~4-4.25 mm, the tuba is strongly ascending *P. megalostoma* sp. nov.
- 26 Shell is small, H ~1.9-2.2 mm, the ultimate whorl is about as wide as the penultimate whorl in apertural view, aperture is rather small, about a half of the ultimate whorl's width *P. papuamontis* sp. nov.
- Shell is large, H ~3.6-4 mm, the ultimate whorl is significantly broader than the penultimate whorl in apertural view, aperture is more than half of the ultimate whorl's width *P. erythropeplos*
- 27 Axial ribs simple and not c-like bent on the periphery of the last two whorls 28
- Axial ribs very widely-spaced and c-like bent on the last two whorls, the outer peristome expands very strongly wing-like beyond the inner one *P. tanimbarensis* sp. nov.
- 28 Axial ribs not very distant (there are more than 8 ribs per 1 mm on the penultimate whorl in apertural view), the outer peristome is not wing-like even if it expands beyond inner one 29
- Axial ribs very distant (about 4–6 ribs per 1 mm on the penultimate whorl in apertural view) except at the constriction, they are lamella-like (fragile), the outer peristome strongly wing-like expands beyond the inner one (Plate 41 figs 10-19) *P. mirifica* sp. nov.
- 29 Shell distinctly conical, axial ribs in a form of high lamellae (these lamellae are fragile and easily get broken, especially in older specimens) 30
- Shell conical or of different shape, axial ribs are not lamella-like 32
- 30 The ultimate whorl is narrower than the penultimate whorl in apertural view, axial ribs are not tilted in a direction opposite to the coiling axis 31
- The ultimate whorl is about as wide as the penultimate whorl in apertural view, axial ribs are tilted in a direction opposite to the coiling axis at least on the penultimate whorl (Plate 44 fig. 21) *P. ponsonbyi*
- 31 Axial ribs are humped and high (Plate 37 figs 13-17), columella with backwards directed median knob (Fig. 55) *P. dohertyi*
- Axial ribs are not humped and comparatively lower (Plate 32 figs 14-19), columella without median knob but is inconspicuously twisted medially (Figs 44-45) *P. attenboroughi* sp. nov.
- 32 Shell with a strong (large and distinctly angulate) bulb beyond the constriction (visible in apertural view) 33
- When present the post-constriction bulb is inconspicuous (flat) 34
- 33 Axial ribs are significantly more distant on early whorls than on the last two whorls (Plate 40 figs 14-16), the penultimate whorl is somewhat bulbous in apertural view, shell H ~4 mm *P. aerari*
- Axial ribs almost equally dense on all teleoconch whorls (Plate 34 figs 1-3), the penultimate whorl is not bulbous in apertural view, shell H ~3 mm or less *P. bougainvillei* sp. nov.
- 34 Tuba is not protruding from shell outline 35



- Tuba is protruding from shell outline (Plate 45, figs 23-24) *P. schneideri* 50
- 35 The inner peristome is discontinued parietally or entire and expanding, but then it covers less than a half of the ultimate whorl in apertural view 50
- The inner peristome is entire and expands strongly, covers a half or more of the ultimate whorl 36
- 36 The penultimate whorl is not or slightly bulbous, not or slightly wider than the ultimate whorl in apertural view 37
- The penultimate whorl bulbous, significantly wider than the ultimate whorl in apertural view *P. papuanorum* 37
- 37 Shell broadly conical with evenly widening teleoconch whorls (Plate 35 figs 21-23, plate 38 figs 10-12, plate 47 figs 20, 22-24) 38
- Shell either obese conical, cylindrical, subcylindrical or subovate with conical or flattened apex, the teleoconch whorls widen rapidly 40
- 38 Peristome is circular (the parietal margin is not straight), not covering all of the penultimate whorl .. 39
- Peristome is subquadrate (the parietal margin straight), expands very strongly and completely covers the ultimate whorl *P. clappi* 39
- 39 Axial ribs more widely-spaced, there are about 6 ribs per 0.5 mm on the penultimate whorl (in apertural view), axial lamellae are very dense and delicate at the end of tuba near the peristome, shell is somewhat slender *P. wisemani*
- Axial ribs denser, there are ~7-8 ribs per 0.5 mm, axial lamellae are stronger (higher) and more distant at the end of tuba, shell generally broader *P. floridensis* 40
- 40 All teleoconch whorls with almost uniform dense straight or sinuous ribs 41
- Two first teleoconch whorls with very peculiar axial ribbing pattern – ribs are curved backwards and form cup-shaped pits *P. cupulifera* 41
- 41 Axial ribs straight or oblique against the coiling axis on the penultimate whorl in apertural view, ribs are not strongly sinuous, shell H not exceeding 3.6 mm 42
- Axial ribs strongly oblique against the coiling axis on the penultimate whorl in apertural view and are distinctly sinuous, shell H ~3.9 mm *P. consobrina* 42
- 42 Peristome has two protrudings - near the palatal / parietal and the parietal / columellar junctions (best visible in lateral view) (Plate 39 figs 1 & 3, plate 45 figs 18-19, plate 46 figs 15 & 17) 43
- Peristome without protrudings 45
- 43 Axial ribs are high, somewhat like low lamellae (Plate 39 figs 104, plate 46 figs 15-17) 44
- Axial ribs are moderately high (Plate 45 figs 18-20), there are 7 ribs per 1 mm *P. scaevola* 44
- 44 Columella with a strong basal knob, there are 9-10 axial ribs per 1 mm *P. laszloi* sp. nov.
- Columella is simple with an obtuse median angulation, up to 5 axial ribs per 1 mm ... *P. sparselamellata* sp. nov. 45
- 45 The outer peristome is not visible beyond the expanded margin of the inner peristome in apertural view or only parts of it are visible 46
- The outer peristome is slightly expanded, is visible beyond the inner one in apertural view *P. leptotoreutos* 46
- 46 Shell not strongly obese (Plate 38 figs 29-31, plate 39 figs 12-14, plate 44 figs 26-29), the maximum height of the peristome is less than 50% of shell height 47
- Shell strongly obese, the maximum height of the peristome is about 50% of shell height 49
- 47 Columellar margin of the peristome is straight or almost straight 48
- Columellar margin of the peristome is sinuous *P. propinqua* 48
- 48 The palatal margin of the inner peristome slightly sinuous, the penultimate whorl is as wide as the previous in lateral view (Plate 39 figs 12-14) *P. liliputana*
- The palatal margin of the inner peristome is straight, the penultimate whorl is slightly narrower than the previous one in lateral view (Plate 38 figs 29-31) *P. inconspicua* 49
- 49 Aperture is circular, the position of the aperture is shifted left against the coiling axis in apertural view, shell is stronger obese (Plate 45 figs 15-17) *P. repandostoma*
- Aperture is ovoid, the aperture is more or less centered below the penultimate whorl in apertural view, shell is generally slender with conical protoconch (Plate 47 figs 17-19) *P. wawiyai* sp. nov. 50
- 50 Suture is moderately or deeply impressed and whorls are convex, the outer peristome without or with less than four protrudings 51
- Suture and whorls are rather flat, the outer peristome with four obtuse protrudings (Plate 45 figs 10-14) *P. quadricornis* 51
- 51 Shell about twice higher than broad, shell slender and distinctly conical (Plate 34 figs 13-15, plate 37 figs 22-24) 52
- Shell less than twice higher than broad or shell shape is cylindrical, obese or fusiform and not conical 53
- 52 Maximum diameter of the peristome in fully grown specimens is significantly narrower than the ultimate whorl in apertural view (Plate 34 fig. 13) ... *P. bundiana*
- Maximum diameter of the peristome in fully grown specimens is almost as wide as the ultimate whorl in apertural view (Plate 37 figs 22 & 28) *P. extrema* sp. nov. 53
- 53 The peristome with two or more obtuse angulate sometimes inconspicuous protrudings 54
- The margins of the outer peristome are straight or sinuous, not developed into angulate protrudings 58
- 54 Peristomal protrudings are derived from the outer peristome, columella without an internal callus 55
- Protrudings are derived from both the inner and the outer peristomes, columella is broad and smooth with glass-like semitransparent callus around its inner margin (Plate 40 figs 17, 19-20) *P. mengen* sp. nov. 55
- 55 Shell subovate, rather obese in median part, columella without knob 56
- Shell cylindrical, columella with a very large backwards directed knob (Fig. 82) *P. paradisaea* sp. nov. 56
- 56 Operculum with a small Γ-like median “handler” on the inner surface (Plate 41 figs 28-30, plate 43 figs 10-



- 12) 57
– Operculum with a large and broad handle-like median protruding on the inner surface, columella is simple (Plate 33 figs 10-12) *P. bicornis*
57 Columella with a median knob which is visible in the aperture as a small columellar denticle (Figs 75-76)
..... *P. misoolensis* sp. nov.
– Columella is simple and thin, without knob (Fig. 80) ..
..... *P. onin* sp. nov.
58 Shell generally conical, the teleoconch whorls widen evenly 59
– Shell of different shape, the teleoconch whorls widen rapidly 60
59 Shell generally slender and higher, H ~3.7-6 mm
..... *P. novopommerana*
– Shell generally smaller, H ~2.7-3.5 mm *P. commixta* [additional material is required to uncover additional specific characters of these two similar species]
60 The outer peristome expands strongly beyond the inner one, broadly encircles the aperture and is broadly discontinued parietally 61
– The outer peristome is not or partly expanding beyond the inner one, not encircling the aperture (if encircling, than is not extraordinary broad) 62
61 Shell is comparatively slender, axial ribs are denser (17-18 ribs per 1 mm on the penultimate whorl), axial ribs not becoming higher on the ultimate whorl
..... *P. granulum*
– Shell is comparatively broader, axial ribs are widely-spaced (about 7 ribs per 1 mm on the penultimate whorl), axial ribs becoming high on the ultimate whorl ..
..... *P. silvicultrix* sp. nov.
62 Shell obese, short subovate with the last two whorls much wider than the previous ones 63
– Shell slender, the last two whorls less strongly wider than the previous ones 65
63 Shell H ~1.75 mm (less than 2 mm)
..... *P. imperfecta* sp. nov.
– Shell H over 2 mm 64
64 The constriction situated on same axis with the parietal side of the aperture, it is defined by denser axial ribs and a sutural impression, shell H ~3.8 mm .. *P. glabella*
– The constriction situated on same axis with the columellar side of the aperture, it is defined by denser axial ribs and a sutural impression, shell H ~2.1-2.3 mm
..... *P. obiensis* sp. nov.
65 Axial ribs becoming max. 2.5x more distant on tuba 66
– Axial ribs becoming 3x more distant on tuba, shell is cylindrical, the palatal margin of the inner peristome is strongly sinuous *P. hartmanni* sp. nov.
66 Shell H less than 3 mm, other characters not meet together like in antithesis 67
– Shell H ~3.5 mm, axial ribs very delicate and rather high, spiral striae very delicate (Plate 35 figs 15-17)
..... *P. citrinella*
67 The operculum is derivative - high (tuba-like), with several layers of concentric lines on the outer surface (Plate 31 fig. 6 & plate 45 fig. 9) 68
– The operculum with or without concentric ridges but is not tuba-like on the outer surface 69
68 Shell rather slender but not conical, the penultimate and the ultimate whorls almost equally wide in apertural view (Plate 31 figs 1-3) *P. adelpha*
– Shell less slender with maximum width on the penultimate whorl (in apertural view) and with broadly conical apex (Plate 45 figs 1-6) *P. psittricha* sp. nov.
69 Columella is straight, slightly curved or twisted, without median knob 70
– Columella with a large median backwards directed knob (Fig. 53) *P. doberai* sp. nov.
70 Axial ribs becoming max 2x more distant on tuba .. 71
– Axial ribs becoming 2.5x more distant on tuba, shell 1.8-2x higher than broad (Plate 39 figs 18-20)
..... *P. louisade* sp. nov.
71 Shell apex conical, shell is not regularly cylindrical ..
..... 72
– Shell apex is flattened, shell is regularly conical ... 73
72 Columella is rather broad with glass-like semitransparent inner edge (Figs 40-42), shell is predominantly dextral with known sinistral specimens *P. angulata*
– Columella is thin and straight (Fig. 97)
..... *P. yamdena* sp. nov.
73 Spiral striae are rather distinct at 80x magnification (but very delicate and dense at 300x magnification) .. 74
– Spiral striae are lacking at 80x magnification (but very delicate and dense at 300x magnification, there are 9-10 rows of spiral striae per 30 µm measured above the aperture), several lamellae present between the inner and the outer peristome ... *P. flavocylindrica* sp. nov.
74 Columella without basal knob, there are significantly less than 25 ribs per 0.5 mm 75
– Columella with basal knob, there are two rather strong lamellae between the inner and the outer peristome, there are 4 rows of spiral striae per 30 µm (measured above the aperture), 25-28 ribs per 0.5 mm
..... *P. minuscularia* sp. nov.
75 Shell less than 2x higher than broad, peristome is double or triple 76
– Shell rather high cylindrical, about 2x higher than broad, peristome is triple (Plate 32 figs 24-26), shell H ~1.8-2 mm *P. beilanensis*
76 Shell H ~1.1-1.6 mm, peristome is thin in lateral view and consists of a few lamellae 77
– Shell H ~1.8-1.95 mm, peristome is triple, rather broad in lateral view and consists of several dense lamellae, the outer peristome is not or slightly stronger than the inner one (Plate 38 figs 26-28) *P. insulana* sp. nov.
77 The operculum is without concentric ridges 78
– The operculum with low concentric ridges and a shallow median impression on the outer surface *P. biroi*
78 Axial ribbing pattern changes evenly starting from the constriction 79
– There are abrupt changes in the axial ribbing pattern - starting from the constriction the ribs becoming coarser and twice more distant 80
79 With a short zone free of axial ribs at the constriction *P. iha* sp. nov.



- Axial ribbing pattern not discontinued at the constriction *P. albrechti* sp. nov.
- 80 Shell generally lower (Plate 39 figs 5-7), $W = 4\frac{3}{4}$ -5, axial ribs more widely-spaced and stronger oblique to the coiling axis, the outer peristome expanding less strongly, columella widening basally (Figs 65-66)
..... *P. lengguru* sp. nov.
- Shell generally higher (Plate 47 figs 8-13), $W = 5\frac{1}{2}$, axial ribs are denser and slightly oblique to the coiling axis, the outer peristome is comparatively more expanding, columella not widening basally (Figs 94-95)
..... *P. waigeo* sp. nov. [the specimen from Wayag has denser ribs on the tuba than Waigeo specimens]

Biogeographic assessment of the Papuan and Wallacean Diplommatinidae (Sulawesi excluded)

Data accumulated during this study allows a preliminary biogeographic assessment. The paucity of phylogenetic information and unequal data available for different parts of the study area prevent this assessment from being comprehensive. Data on species richness and endemism for certain islands and insular groups are discussed in table 19. Generally, *Palaina* is the most diverse genus in this part of the world while *Diplommatina* represents another species-rich group with highest diversity on the Sunda and Banda arcs islands. Species diversity of *Diplommatina* decreases significantly east of Timor and the North Moluccas. Vice versa, *Palaina* becomes less diverse on the Sunda Arc and the Moluccas than it is in Raja Ampat, New Guinea and the Solomon Islands.

Table 19. Geographical records of the Diplommatinidae in Wallacea (Sulawesi excluded) and the Papuan Region.

Geographic island group	Island or geographical part of large island	Number of Diplommatinidae taxa	Endemism
Aru Islands		4	75%
	Kobroor	2	50%
	Maikoor	1	100%
	Tanahbesar	1	100%
Bismarck Archipelago	New Britain	5	100%
Lesser Sunda (Nusa Tenggara) Islands		20	85%
	Flores	8	87%
	Lombok	1	100%
	Sumba	10	60%
	Timor	3	66%
The Moluccas (Aru & Tanimbar islands excluded)		21	100%
of them North Moluccas		15	100%
of them Central Moluccas		6	100%
of them Lease Islands		4	75%
	Ambon	4	20%
	Bacan	1	100%
	Buru	1	100%
	Halmahera	4	75%
	Haruku	3	0%
	Obi Islands (Obira & Belangbelang)	8	87%
	Saparua	2	0%
	Seram	2	50%
	Talaud Islands	1	100%
	Ternate & Tidore	3	66%
Louisiade Islands		2	100%
	Basilaki	1	100%
	Misima & Rossel	1	100%
New Guinea (Cenderawasih Bay Islands excluded)		25	92%
	North New Guinea	6	83%
	Doberai (Bird's Head) Peninsula (southern lowlands only)	4	100%
	West Papua (Onin Peninsula, Bird's Neck Isthmus)	11	92%
	Central Cordillera	2	50%
	East New Guinea (Madang, Milne Bay, Morobe provinces)	5	80%
Cenderawasih Bay Islands		6	100%



	Biak & Owi	6	83%
	Yapen	1	0%
Raja Ampat Islands		25	92%
	Misool, Polee & Yan	16	87.5%
	Waigeo	11	91%
	Wayag	2	50%
Tanimbar Islands	Yamdena	4	100%
Solomon Islands		8	100%
	Bougainville & Buka	1	100%
	Guadalcanal	2	0%
	Nggela (= Florida)	3	66%
	Mono	3	33%
	Makira (= San Cristobal) & Owaraha (= Santa Ana)	2	100%

Lesser Sunda Islands (Nusa Tenggara) species

The Lesser Sunda Islands extend from Lombok in the West to Wetar in the East, forming a chain of small to mid-sized islands of mostly tertiary and quaternary volcanic origin. The largest islands are (west to east) Lombok, Sumbawa, Sumba, Flores, Timor, Alor, and Wetar. While Lombok and Sumbawa situated on the Sunda Arc, other islands of this region are part of the Banda Arc with a geological discontinuity between these two island groups. Being a part of Wallacea, these islands differ considerably from the rest of the study area in their climate and types of habitats. Forests are less common because seasonally dry periods limit forest development and this naturally patchy forest is further reduced by human activity. Lowland forests of the Lesser Sunda Islands are mostly seasonal, and separated by vast grasslands.

Distribution of diplommatinids on these islands is limited to wet montane forests (Sumba, Flores, montane areas of western part of Timor) as well as high altitude limestone outcrops in open areas (eastern part of Timor). Compared to other insular systems within the study area, the diplommatinid fauna of the Lesser Sunda Islands is peculiar due to its high relative diversity of *Diplommatina* species. Of totally 20 diplommatinid species currently reported from Lesser Sunda Islands, there are 12 *Diplommatina* and 8 *Arinia* / *Palaina* species (although there are few characters differentiating the two genera, as a result there is taxonomic uncertainty between the two genera, consider notes above). *Diplommatina* may be an element of Oriental origin spreading from Greater Sunda Islands eastwards across Sunda Arc and later - Banda Arc islands. While *Palaina*, the most diverse diplommatinid group in the Papuan Region, reach Java from the opposite direction. No diplommatinid records are hitherto known from Alor, Sumbawa and Wetar. Recent material for this study was available from Flores, Timor and Bali (the latter island is outside

the study area but lies in proximity of Lombok). Material from Timor-Leste was not available.

Only one diplommatinid species is probably endemic to Lombok.

The Malacofauna of Sumba comprises 6 *Diplommatina* species (one is shared with Greater Sunda Islands, another one with West Timor) and 3 *Arinia* species of which *Arinia* (s. l.) *tjendanae* B. Rensch, 1931 is also known from the Aru Islands.

Flores has one *Arinia*, 4 *Diplommatina* (one species shared with Greater Sunda Islands) and 3 *Palaina* species.

The dry western part of Timor is poorly sampled with 2 *Diplommatina* species (one is shared with Sumba), as well as one *Palaina* species ².

Generally, the Lesser Sunda Islands are insufficiently researched for Diplommatinidae and the real number of species here is certainly much higher than presently known.

Tanimbar Islands species

The Tanimbar Islands, which were formerly also known as Timorlaut have never been a part of Sahul and never been connected to the Australian plate. The nearest distance between the Tanimbars and the Sahul shelf is about 30 km. Instead, the Tanimbar Islands are the easternmost extension of the Banda Arc. The malacofauna of the Tanimbar Islands is of various origin both Asian and Australian (Vermeulen 1996b). Colonization of the islands from Asia was possible across the Sunda and Banda arcs islands and colonization from Australia was possible across relatively short distances from nearby Papuan islands.

Four *Palaina* species are known from Yamdena, the largest of the Tanimbar Islands, all of them

2 Over ten Diplommatinidae species were collected in Timor-Leste by the Australian Museum expeditions (according to <https://australianmuseum.net.au/image/land-snails-of-timor-leste-2>). As stated above, this material was not available for my study.



were collected recently and are described in the present work.

Moluccan species

The Moluccas (or Maluku), some thousands of small and a few mid-sized islands, are of various geological origins. For example, the islands that became the arms of Halmahera were in proximity to the north-western coast of New Guinea in their geological past (Polhemus 2007) while the western part of this island is part of a young volcanic belt (Hall et al. 1988). Three main geographical groups can be recognized within the Moluccas: the North Moluccas, which include the Talaud Islands, of which Halmahera, Bacan, Morotai and Obira are the largest; the Central Moluccas of which Seram and Buru are the largest; the South-Eastern Moluccas (from where no Diplommatinidae material was available), which include Key Islands, Banda Islands. The Sula Islands, including Taliabu and Mangole, are administratively part of the North Moluccas but are rather isolated geographically. The Moluccas are covered by lowland rainforests, with few high mountains available (for example, the Manusela Range on Seram).

In total, 21 diplommatinid species are reported from the Moluccas. No records are hitherto available from the South-Eastern Moluccas or the Sula Islands.

The “classic” North Moluccas (Sula Islands excluded) harbour 15 currently known diplommatinid species, none of which shared with other island groups. This is the only island group in the study area from where *Diancta* species are known (5 species in total). *Diplommatina* and *Palaina* are represented by 4 species each, while *Arinia* and *Moussonia* - by one each. Three geographically separated island groups can be recognized within the North Moluccas: a northern group including Halmahera, Bacan, Morotai and their adjacent islands; a southern group, the Obi Islands; and an eastern group encompassing Gebe, Ju and adjacent islets (see Greke 2012 for further data on the malacofauna of Gebe Island). No diplommatinid records are hitherto available from Gebe. Diplommatinids are represented by 8 species on the southern islands of which only *Diplommatina* (s. l.) *radiiformis* Preston, 1913 is shared with the northern group, as well as with Belangbeland Island and on the northern arm of Halmahera and on Tidore.

The Central Moluccan diplommatinid fauna is comprised of only 6 species, 3 each of *Moussonia* and *Palaina*. Prior to this study, an “endemic”

monotypic genus *Anostomella* was described from this region, which is synonymized with *Palaina* in the present publication. Large islands of Buru and Seram have only one and two diplommatinid species respectively, while small and limestone rich Lease Islands just south of Seram are inhabited by 5 species. The Lease Island species have successfully survived centuries of human activities in this area. No recent material was available from Buru Island for this study.

The total number of diplommatinid species is hard to predict for the Moluccas, but it should be at least 4x higher than the 21 species that are presently known.

Raja Ampat species

Of five main islands forming this group: Batanta, Kofiau, Misool, Salawati, Waigeo, diplommatinid material is hitherto only available from Misool, Waigeo, as well as from tiny Polee (Yfpolee) and Wayag. Misool and Waigeo have different geological histories. The Raja Ampat Islands are covered by dense lowland rainforests.

Misool Island is most distant from New Guinea's Doberai Peninsula, about 70 km at closest distance, and about 60 km from Salawati. But this island is fully docked to the western margin of the Australian craton (Beehler 2007). Waigeo lies on the Papuan platform and is situated closer to Doberai and Salawati, but separated from them by the submarine trace of the Sorong Fault. Islands that later became parts of Waigeo were in proximity to the north-western coast of New Guinea in their geological past (Polhemus 2007).

The Misool diplommatinid fauna demonstrates similarity with the lowland fauna of western New Guinea. Eight species were known, mostly from the NW part of the island, an additional 8 species were discovered from our recent surveys in the central and southern parts of the island. One *Diplommatina*, 4 *Moussonia* and 11 *Palaina* species hitherto known from Misool. *Diplommatina* (s. l.) *telnovi* sp. nov. and *Palaina* (s. l.) *novoguineensis* E.A. Smith are shared with Doberai and Onin peninsulas of New Guinea. I project the total number of the Diplommatinidae is at least twice higher on Misool since most of this island remains unexplored by malacologists.

One *Palaina* species also found on a nearby Polee (Yfpolle) Island but is not yet discovered on Misool itself.

The Diplommatinid fauna of Waigeo is comprised of eleven species, of which only one was



known prior to this study. One *Diplommatina* and 10 *Palaina* species occur on Waigeo. None of these species are shared with other geographical areas. Two of the 11 species are already reported from both the western and eastern peninsulas of the island, while 9 species considered restricted to the western peninsula. Additional studies need to be carried out, especially in the eastern and northern parts of the island. I consider the real number of Misool diplommatinid species could be at least 3x higher than presently known. *Palaina waigeo* sp. nov. was also discovered on nearby Wayag islet.

Wayag itself harbors at least two *Palaina* species, one of which is presumably endemic.

A total of 28 diplommatinid species are currently recorded from the Raja Ampat Islands.

Aru Islands species

The Aru Islands are low-lying limestone land-bridge islands on the Papuan platform with the fauna generally similar to the southern lowlands of New Guinea (Beehler 2007; Polhemus & Allen 2007). The Aru Islands are covered by dense lowland rainforests. One new and three previously known diplommatinid species: 1 of each *Arinia*, *Diplommatina*, *Moussonia*, and *Palaina* have been reported from Aru. Currently, three species considered endemic to Aru but their occurrence in southern New Guinea is not fully excluded. The record of *Arinia* (s. l.) *tjendanae* B. Rensch, 1931 from Aru Islands is interesting since this species was initially described from Sumba Island of Nusa Tenggara over 1600 km west from Aru. Record of this species in Aru is from primary rainforest habitat, therefore a chance of import from Lesser Sunda Islands is considered low. Without doubt, the diplommatinid fauna of the Aru Islands is not completely known.

Cenderawasih Bay Islands species

Biak, Owi and Supiori islands were not connected to the Papuan platform during the Pleistocene (Polhemus & Allen 2007). While Biak is of Quaternary limestone origin, Supiori demonstrates exposures of island arc volcanics (Polhemus & Allen 2007). Yapen is a land-bridge island and a part of the Mobile Belt affiliated with the Sorong fault (Beehler 2007). The vertebrate fauna and aquatic invertebrate fauna of Yapen is almost lacking endemism (Beehler 2007; Polhemus & Allen 2007) and is similar to the fauna of the north-western lowlands and northern coastal ranges of New Guinea. The rugged Cenderawasih Bay Islands are covered

by dense lowland rainforests but flat Biak Island is badly deforested.

Six diplommatinid species, all of the genus *Palaina*, are currently known from Biak and nearby Owi. One of these species is also found on Yapen (see below).

The malacofauna of Yapen is very poorly known and *Palaina* (s. l.) *propinqua* van Benthem Jutting, 1963, is the only diplommatinid species known from there, and is shared with Biak.

No Diplommatinidae records are hitherto known from Numfoor and Supiori.

No recent material was available from Cenderawasih Bay islands for the present study. I estimate the diplommatinid fauna of Biak, Numfoor, Supiori and Yapen will probably include at least 30 species.

New Guinea species

New Guinea is not only World's largest tropical island, but also the most diverse one in terms of available habitats and altitude gradients. Besides Seram, New Guinea is the only island in the study area with alpine vegetation and mountains reaching over 3000 m. The Geological history of New Guinea is very complex and remains incompletely resolved (Polhemus 2007). However, many of New Guinea's habitats, for example alpine habitats, are not likely to be suitable for diplommatinids (see subchapter "Areas where no Diplommatinidae found or expected" below).

Very limited historical material and recent collections of Diplommatinidae are available from New Guinea. Eight species (all *Palaina*) were known from New Guinea prior to this study. Now 25 species are recorded from New Guinea (land area 785753 km², compare with 16 species known from Misool of 2034 km²). Of these 25 species two are shared with Misool Island and 23 considered endemic to particular mountain ranges and geological terranes on New Guinea.

With regard to the geological history of New Guinea and in terms of endemism, I declare Dobera Peninsula (also known as Bird's Head or Kepala Burung) inclusive Bird's Neck Isthmus as an area of endemism for terrestrial snails besides other areas (like northern New Guinea, Central Cordillera).

Except one record based on misidentification species from Manokwari surroundings (van Benthem Jutting 1963), no diplommatinid records from Dobera Peninsula were published until now. Despite intensive searches, Diplommatinidae are unknown from the mountainous northern half of the peninsula (Arfak & Tamarau mountains) while



4 species (*Diplommatina* and *Palaina* 2 each) are known from southern lowlands of Doberai. Bomberai Peninsula is an area without diplommatinid records while the attached Onin Peninsula harbors 8 species (2 *Diplommatina*, 1 *Moussonia*, 5 *Palaina*). Of these *Diplommatina* (s. l.) *telnovi* sp. nov. is shared with lowlands of Doberai Peninsula and Misool Island and *Palaina* (s. l.) *novoguineensis* E.A. Smith, 1897 also occurs on limestone anticlines of the Bird's Neck Isthmus. Phylogenetically very conspicuous *Moussonia pseudoseparanda* sp. nov. has its closest relatives *M. monstificabilis* sp. nov. and *M. separanda* sp. nov. on Misool Island. The Bird's Neck anticline houses a fauna of 5 species (1 *Moussonia* and 4 *Palaina*).

Northern New Guinea has a different geological past and is inhabited by 6 species (1 *Moussonia* and 5 *Palaina*) of which *Palaina* (s. l.) *papuanorum* Soós, 1911 also known from eastern New Guinea. Two *Palaina* species known from Lake Sentani surroundings while one *Moussonia* and one other *Palaina* considered endemic to the Torricelli Mountains.

The Eastern part of New Guinea is inhabited by 5 *Palaina* species of which one is shared with northern New Guinea (see above).

Only one peculiar species *Palaina* (s. l.) *papua-montis* sp. nov. is known from New Guinea's Central Cordillera.

It is slightly possible to estimate the potential richness of New Guinea's diplommatinid fauna, but it is likely to be at least 100 species.

Louisiade Islands species

The Louisiade Islands are a string of ten rather small volcanic islands frequently fringed by coral reefs, and numerous coral islets located just southeast to nearly 200 km southeast of New Guinea, stretching over more than 160 kilometres, these islands are covered by lowland and lower montane rainforests.

One *Diplommatina* and one *Palaina* are known from these islands while 10 more species are predicted.

Bismarck Archipelago species

The Bismarck Archipelago, including the Admiralty Islands, are islands of volcanic origin situated between New Guinea and the Solomon Islands. There are also vast areas of raised limestone and deep limestone caves. Main islands are New Britain, New Ireland, Manus, and New Hanover. These

islands covered by dense lowland to mid-montane rainforests. Diplommatinidae records are only available from New Britain Island. This includes both historical as well as a limited recent material.

Only 5 *Palaina* species are currently known from New Britain, none of them is shared with other archipelago's islands or New Guinea. The estimated total diplommatinid fauna of this archipelago will probably be at least 5x higher.

Solomon Islands species

Geologically the Solomon Islands consist of a double chain of volcanic islands and coral atolls including the Papua New Guinea's autonomous territory of Bougainville which includes Buka and neighbour islands. Except the two aforementioned, other islands of the archipelago lie in two parallel chains running northwest to southeast. Volcanoes are abundant and the terrain is mountainous, with peaks up to 2330 m.

The diplommatinid fauna consists of eight *Palaina* species, all endemic to the archipelago. *Palaina* (s. l.) *aerari* (Dell, 1955) and *Palaina* (s. l.) *gardneri* Dell, 1955 are two species with largest distribution area of about 600 km shared between Bougainville, its adjacent islands and the Guadalcanal Islands. The remaining 6 species are more limited in their distribution. No diplommatinid material is hitherto available from large islands of Choiseul, Malaita, New Georgia and Santa Isabel. No recent material from the Solomon Islands was available for this study. Additional studies are required throughout the Solomon Islands and the projected number of diplommatinid species is probably at least 5x higher than present.

Areas where no Diplommatinidae were found or are expected

Diplommatinids are silvicolous snails closely connected with forest habitats especially rainforests. Like many other terrestrial molluscs Diplommatinidae are most abundant and diverse on calcareous soils. Granite, igneous, clay, and slate substrates are widely known as unfavourable for them (Beddard 1895). The geological history of Wallacea and the Papuan Region is very complex (Polhemus 2007). Distribution of soils in the study area is influenced by the combined effect of major soil-forming factors, namely climate, vegetation, relief, parent material, and time (Hope & Hartemink 2007). Since distribution of favourable and less favourable habitats (e.g. forests versus open



habitats, limestone soils versus granite, basalt or clay, dry and semidry areas versus wet areas) have some peculiarities, there are certain parts within the study area where diplommatinid snails were not found and are not expected (Maps 2-4). It is speculative to declare absence of a species or a group in a certain area, because confirming the absence of a species is much more time-consuming than confirming its presence, especially for minute species like diplommatinids that require sieving and other specialized sampling techniques. This statement is based on my personal experience in 2007-2017 and on the calculations, taking into account the area and present diversity.

1. Southern semidry eucalypt forests on ultisol (clay), Trans-Fly savannah: Our extensive studies gave no results and it is unlikely this large area is inhabited by diplommatinids. Gallery rainforests along numerous watercourses however can hold diplommatinid populations and are potential distribution corridors for them.

2. The Central Cordillera above the tree line: Generally, the upper montane (2500 m and over) rainforest areas, and areas over tree line. No diplommatinid material is available from high altitudes in the study area, no species are known from coniferous and myrtle forests, as well as from the alpine vegetation.

3. Lowland swamp areas in southern New Guinea: Our extensive studies failed to find diplommatinids in these habitats and it is unlikely this large area is inhabited by diplommatinids.

4. Basalt, granite, and heavy metals rich rock formations are unlikely to contain diplommatinids, although the presence of diplommatinid snails is not completely excluded. My intensive surveys in granite rock and soil areas in southern Misool near Aduway village failed to uncover any Diplommatinidae, although nearby areas just 15 km N or 26 km NE of Aduway support over 15 diplommatinid species. Similarly, the predominantly igneous Tamarau Mountains did not harbour any species despite presence of isolated limestone areas. Also Arfak mountains along a transect from Ransiki toward Mokwam village through Anggi Lakes area gave no diplommatinid snails. Areas like northern Waigeo and adjacent Manuran islet, western tip of Obira, E tip of SE arm of Halmahera (area N and NE of Patani) do not harbour any diplommatinids primarily because of presence of heavy metals in the soil.

5. Mangrove forests with high salt content generally considered unsuitable for terrestrial soil dwelling snails.

Annotated list of the Papuan and Wallacean Diplommatinidae (Sulawesi excluded)

See Hamer & Slotow (2002) for categories of endemism.

***Arinia* s. l. H. et A. Adams, 1856** (5 species)

Arinia (s. l.) *blanda* E.A. Smith, 1897

Distribution: Flores Island (Lesser Sunda Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Arinia (s. l.) *crassiventris* B. Rensch, 1931

Distribution: Sumba Island (Lesser Sunda Islands).

Endemism: geographical, regional, local endemic.

Number of localities: 3 (pre-1990), 0 (post-1990).

Habitat: seasonal secondary & primary forests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Arinia (s. l.) *patagiata* van Benthem Jutting, 1958

Distribution: Sumba Island (Lesser Sunda Islands).

Endemism: geographical, regional, site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: Areca & coconut stand.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Arinia (s. l.) *talautana* (Fulton, 1899)

Distribution: Talaud Islands.

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Arinia (s. l.) *tjendanae* B. Rensch, 1931

Distribution: Sumba Island (Lesser Sunda Islands), Kobroor Island (Aru Islands).

Endemism: widely distributed.

Number of localities: 3 (pre-1990), 1 (post-1990).

Habitat: riverine forests, primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

***Diancta* s. str. Martens, 1864** (5 species)

Diancta (s. str.) *constricta* (Martens, 1864)

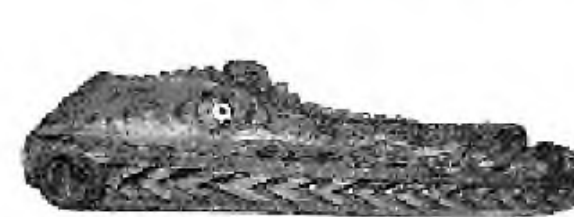
Distribution: Ternate & Tidore islands (North Moluccas).

Endemism: geographical, regional & local endemic.

Number of localities: 1 (pre-1990), 1 (post-1990).

Habitat: primary & secondary lowland rainforests.

Altitude zone: lowlands.



IUCN assessment: Endangered.

Diancta (s. str.) *halmaherica* sp. nov.

Distribution: Halmahera Island (North Moluccas).

Endemism: geographical, regional & local endemic.

Number of localities: 2 (post-1990).

Habitat: primary & secondary lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Vulnerable.

Diancta (s. str.) *multiplicata* von Möllendorff, 1902

Distribution: Obi Islands (North Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: unknown.

IUCN assessment: Data Deficient.

Diancta (s. str.) *obiensis* sp. nov.

Distribution: Obira Island, Obi Islands (North Moluccas).

Endemism: geographical, regional & local endemic.

Number of localities: 2 (post-1990).

Habitat: secondary lowland rainforests, gardens.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Diancta (s. str.) *torta* O. Boettger, 1891

Distribution: Bacan Island (North Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

***Diplommatina* s. l. Benson, 1849 (22 species)**

Diplommatina (s. l.) *baliana* (Fulton, 1899)

Distribution: Sumba Island (Lesser Sunda Islands), Bali, Java, Madura islands (Greater Sunda Islands).

Endemism: widely distributed.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: primary lowland to mid montane rainforests on limestone & volcanic soils.

Altitude zone: lowlands up to 2900 m.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *decollata* van Benthem Jutting, 1958

Distribution: Sumba Island (Lesser Sunda Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: seasonal secondary & primary forests, lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *floresiana* E.A. Smith, 1897

Distribution: Flores Island (Lesser Sunda Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 1 (pre-1990), 2 (post-1990).

Habitat: lower and mid montane rainforests on volcanic soils.

Altitude zone: 1200-2205 m.

IUCN assessment: Near Threatened.

Diplommatina (s. l.) *floris* B. Rensch, 1931

Distribution: Flores Island (Lesser Sunda Islands).

Endemism: geographical, regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: montane rainforests.

Altitude zone: unknown.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *fluminis* B. Rensch, 1931

Distribution: Sumba, Timor islands (Lesser Sunda Islands).

Endemism: regional endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: riverine forests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *javana* von Möllendorff, 1897

= *Diplommatina javana orientalis* B. Rensch, 1931

Distribution: Flores Island (Lesser Sunda Islands), Bali & Java islands (Greater Sunda Islands).

Endemism: widely distributed.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: primary & secondary lower to mid montane rainforests on volcanic soils.

Altitude zone: up to 2700 m.

IUCN assessment: Least Concern.

Diplommatina (s. l.) *jonabletti* sp. nov.

Distribution: Flores Island (Lesser Sunda Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 1 (pre-1990), 3 (post-1990).

Habitat: primary lower to mid montane rainforests on volcanic soils.

Altitude zone: 1200-2205 m.

IUCN assessment: Endangered.

Diplommatina (s. l.) *leucopsis* van Benthem Jutting, 1958

Distribution: Sumba Island (Lesser Sunda Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: seasonal lowland forests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *lombockensis* E.A. Smith, 1898

Distribution: Lombok Island (Lesser Sunda Islands).

Endemism: geographical & regional endemic, ? site



endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: unknown.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *lucifuga* van Benthem Jutting, 1958
Distribution: Sumba Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: Areca & coconut stand.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *maibrat* sp. nov.
Distribution: southern lowlands of Doberai Peninsula (W New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *mertoni* C.R. Boettger, 1922
Distribution: Maikoor Island (Aru Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *moluccensis* sp. nov.
Distribution: Ternate & Tidore islands (North Moluccas).
Endemism: geographical, regional & local endemic.
Number of localities: 2 (post-1990).
Habitat: secondary lowland rainforests on volcanic soil.
Altitude zone: lowlands.
IUCN assessment: Endangered.

Diplommatina (s. l.) *patani* sp. nov.
Distribution: Halmahera Island (North Moluccas).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: old-growth secondary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *radiiformis* Preston, 1913
Distribution: Belangbelang, Halmahera, Tidore islands (North Moluccas).
Endemism: geographical endemic of North Moluccas.
Number of localities: 1 (pre-1990), 3 (post-1990).
Habitat: primary & secondary lowland rainforests on

limestone & volcanic soils.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Diplommatina (s. l.) *slapcinskyi* sp. nov.
Distribution: Obira Island, Obi Islands (North Moluccas).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary & secondary lowland rainforests, gardens.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *smithi* Kobelt et von Möllendorff, 1898
Distribution: Onin Peninsula (W New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 1 (post-1990).
Habitat: unknown.
Altitude zone: unknown.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *symmetrica* Hedley, 1891
Distribution: Basilaki Island (Louisiade Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 1 (post-1990).
Habitat: *Pandanus* stand.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *telnovi* sp. nov.
Distribution: southern lowlands of Doberai Peninsula, Onin Peninsula (W New Guinea), Misool Island (Raja Ampat Islands).
Endemism: geographical endemic of W New Guinea.
Number of localities: 6 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Diplommatina (s. l.) *timorensis* sp. nov.
Distribution: Timor Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: mid montane limestone rocks.
Altitude zone: 1620-1630 m.
IUCN assessment: Data Deficient.

Diplommatina (s. l.) *torquilla* van Benthem Jutting, 1958
Distribution: Sumba Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.



Altitude zone: unknown.

IUCN assessment: Data Deficient.

Diplommatina (s. l.) *waigeoensis* sp. nov.

Distribution: Waigeo Island (Raja Ampat Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 5 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Endangered.

***Moussonia* O. Semper, 1865** (12 species)

Moussonia athena (Preston, 1913)

Distribution: Belangbelang Island, Obi Islands (North Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient

Moussonia echinata sp. nov.

Distribution: Bird's Neck Isthmus (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia hirsuta (Zilch, 1953)

Distribution: Buru Island (Central Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: unknown.

IUCN assessment: Data Deficient.

Moussonia hyponepia (van Benthem Jutting, 1958) comb. nov.

Distribution: Misool Island (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia manuselae sp. nov.

Distribution: Seram Island (Central Moluccas).

Endemism: geographical, regional, ? local endemic.

Number of localities: 2 (post-1990).

Habitat: primary lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia monstificabilis sp. nov.

Distribution: Misool Island (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Least Concern.

Moussonia omias (van Benthem Jutting, 1958) comb. nov.

Distribution: Misool Island (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia papuana (Tapparone Canefri, 1883)

Distribution: Tanahbesar Island (Aru Islands).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 1 (pre-1990), 1 [identification uncertain] (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia pseudoseparanda sp. nov.

Distribution: Onin Peninsula (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Moussonia separanda sp. nov.

Distribution: Misool Island & Yan islet offshore Misool (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? local endemic (see comments on distribution of this species in its description).

Number of localities: 3 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Least Concern.

Moussonia strubelli (O. Boettger, 1891)

Distribution: Ambon Island, Lease Islands (Central Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: unknown.

IUCN assessment: Data Deficient.



Moussonia torricelli sp. nov.

Distribution: Torricelli Mountains (N New Guinea).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 3 (post-1990).
Habitat: primary lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

***Palaina* s. l. O. Semper, 1865** (77 species)

= *Anostomella* Martens, 1867 syn. nov.

Palaina (s. l.) *adelpha* Soós, 1911

Distribution: Madang Province (NE New Guinea).
Endemism: geographical, regional & local endemic.
Number of localities: 1 (pre-1990), 6 (post-1990).
Habitat: primary lowland to mid montane rainforests on limestone and granite soils.
Altitude zone: up to 2300 m.
IUCN assessment: Least Concern.

Palaina (s. l.) *aerari* (Dell, 1955) comb. nov.

= *Palaina megamorpha* Solem, 1960 syn. nov.

Distribution: Mono Island, Bougainville Group, Florida and Guadalcanal islands (Solomon Islands).
Endemism: geographical endemic of Solomon Islands.
Number of localities: 4 (pre-1990), 0 (post-1990).
Habitat: lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *albrechti* sp. nov.

Distribution: Torricelli Mountains (N New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *angulata* O. Boettger, 1891

Distribution: Ambon, Haruku & Saparua islands, Lease Islands (Central Moluccas).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 4 (pre-1990), 7 (post-1990).
Habitat: primary and secondary rainforests on limestone.
Altitude zone: lowlands up to 1000 m.
IUCN assessment: Endangered.

Palaina (s. l.) *ascendens* (Martens, 1864)

Distribution: Ambon, Haruku & Saparua islands, Lease Islands (Central Moluccas).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 1 (pre-1990), 6 (post-1990).
Habitat: primary and secondary rainforests, gardens.
Altitude zone: lowlands.
IUCN assessment: Endangered.

Palaina (s. l.) *attenboroughi* sp. nov.

Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *beilanensis* Preston, 1913

Distribution: Belangbelang Island, Obi islands (North Moluccas).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *bicornis* van Benthem Jutting, 1958

Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 2 (pre-1990), 2 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *biroi* Soós, 1911

Distribution: Chimbu & Madang provinces (NE New Guinea).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 1 (pre-1990), 10 (post-1990).
Habitat: primary & secondary lowland to upper montane rainforests, gardens.
Altitude zone: lowlands up to 3300 m.
IUCN assessment: Least Concern.

Palaina (s. l.) *bougainvillei* sp. nov.

Distribution: Bougainville, Buka islands, Bougainville Group (PNG part of Solomon Islands).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 2 (post-1990).
Habitat: abandoned coconut plantations, degraded lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *brazieri* (Cox, 1870)

Distribution: Makira (= San Cristobal) Island (Solomon islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: lowland and lower montane rainforests.
Altitude zone: lowlands and lower mountains.
IUCN assessment: Data Deficient.



Palaina (s. l.) *bundiana* Wiktor, 1998

Distribution: Madang province (NE New Guinea).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 3 (post-1990).

Habitat: gardens & degraded rainforests.

Altitude zone: 1300-1400 m.

IUCN assessment: Data Deficient.

Palaina (s. l.) *carbavica* O. Boettger, 1891

Distribution: Ambon, Haruku islands, Lease Islands and Seram Island (Central Moluccas).

Endemism: geographical, regional & local endemic.

Number of localities: 2 (pre-1990), 5 (post-1990).

Habitat: primary & secondary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Near Threatened.

Palaina (s. l.) *chrysostoma* E.A. Smith, 1897

Distribution: Flores Island (Lesser Sunda Islands).

Endemism: geographical, regional & local endemic.

Number of localities: 1 (pre-1990), 2 (post-1990).

Habitat: primary lowland to mid montane rainforests.

Altitude zone: 525-1575 m.

IUCN assessment: Near Threatened.

Palaina (s. l.) *citrinella* van Benthem Jutting, 1963

Distribution: Lake Sentani area (N New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: lowland rainforest on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *clappi* Solem, 1960

Distribution: Nggela (= Florida) Island (Solomon Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: unknown.

IUCN assessment: Data Deficient.

Palaina (s. l.) *commixta* I. Rensch, 1937

= *Palaina commixta jacquinoti* I. Rensch, 1937 syn. nov.

Distribution: New Britain Island (Bismarck Archipelago).

Endemism: geographical, regional & local endemic.

Number of localities: 3 (pre-1990), 4 (post-1990).

Habitat: primary & secondary lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Least Concern.

Palaina (s. l.) *consobrina* van Benthem Jutting, 1963

Distribution: Lake Sentani area (N New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: lowland rainforest on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *cupulifera* van Benthem Jutting, 1963

Distribution: Biak Island (Cenderawasih Bay Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: swampy lowland rainforest on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *dianctoides* sp. nov.

Distribution: Onin Peninsula (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: limestone rocks, primary lowland rainforest.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *diepenheimi* (Preston, 1913) comb. nov.

Distribution: Belangbelang Island, Obi Islands (North Moluccas).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *doberai* sp. nov.

Distribution: southern lowlands of Doberai Peninsula (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Near Threatened.

Palaina (s. l.) *dohertyi* E.A. Smith, 1897

Distribution: Onin Peninsula (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 1 (post-1990).

Habitat: primary lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *erythropeplos* van Benthem Jutting, 1958

Distribution: Misool Island (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).



Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *extremata* sp. nov.

Distribution: Milne Bay Province (E New Guinea).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 2 (post-1990).

Habitat: lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Near Threatened.

Palaina (s. l.) *flavocylindrica* sp. nov.

Distribution: Bird's Neck Isthmus (W New Guinea).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 2 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Least Concern.

Palaina (s. l.) *floridensis* Solem, 1960

Distribution: Nggela (= Florida) Island (Solomon Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: rainforest.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *gardneri* Dell, 1955

= *Palaina delli* Clench, 1965 syn. nov.

Distribution: Mono Island, Bougainville Group & Guadalcanal Island (Solomon Islands).

Endemism: geographical endemic of Solomon Islands.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: rainforest.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *glabella* van Benthem Jutting, 1963

Distribution: Biak Island (Cenderawasih Bay Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *granulum* I. et B. Rensch, 1929

Distribution: New Britain (Bismarck Archipelago).

Endemism: geographical & regional endemic, ? local endemic.

Number of localities: 2 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: unknown.

IUCN assessment: Data Deficient.

Palaina (s. l.) *hartmanni* sp. nov.

Distribution: Waigeo Island (Raja Ampat islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 2 (post-1990).

Habitat: secondary lowland rainforest on limestone.

Altitude zone: lowlands.

IUCN assessment: Near Threatened.

Palaina (s. l.) *iha* sp. nov.

Distribution: Onin Peninsula (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: lowland rainforests.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *imperfecta* sp. nov.

Distribution: Waigeo Island (Raja Ampat Islands).

Endemism: geographical, regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *inconspicua* van Benthem Jutting, 1963

Distribution: Biak Island (Cenderawasih Bay Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (pre-1990), 0 (post-1990).

Habitat: unknown.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *insulana* sp. nov.

Distribution: Polee Island S of Misool Is. (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforest on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *laszloi* sp. nov.

Distribution: Wayag Island (Raja Ampat Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Palaina (s. l.) *lengguru* sp. nov.

Distribution: Bird's Neck Isthmus (W New Guinea).

Endemism: geographical & regional endemic, ? site endemic.



Number of localities: 2 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *leptotoreutos* van Benthem Jutting, 1958
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 2 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *liliputana* van Benthem Jutting, 1963
Distribution: Biak Island (Cenderawasih Bay Islands).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 3 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *lousiade* sp. nov.
Distribution: Misima & Rossel [identification uncertain] islands (Lousiade Islands).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 1 (possible 2 since identification of Rossel Island specimen is not certain) (post-1990).
Habitat: limestone rocks.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *mairasi* sp. nov.
Distribution: Bird's Neck Isthmus (W New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary & secondary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *manggaraica* (E.A. Smith, 1897) comb. nov.
Distribution: Flores Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic, local endemic.
Number of localities: 1 (pre-1990), 2 (post-1990).
Habitat: primary lower montane rainforests.
Altitude zone: 1575-1850 m.
IUCN assessment: Endangered.

Palaina (s. l.) *megalostoma* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).

Habitat: primary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Near Threatened.

Palaina (s. l.) *mengen* sp. nov.
Distribution: New Britain Island (Bismarck Archipelago).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 3 (post-1990).
Habitat: primary & secondary lower montane rainforests.
Altitude zone: 850-900 m.
IUCN assessment: Data Deficient.

Palaina (s. l.) *minuscularia* sp. nov.
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical, regional & local endemic.
Number of localities: 2 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *minutula* sp. nov.
Distribution: Halmahera Island (North Moluccas).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *mirifica* sp. nov.
Distribution: Yamdena Island (Tanimbar Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *misoolensis* sp. nov.
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *mutis* sp. nov.
Distribution: Timor Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: lower montane moist eucalypt forest.
Altitude zone: 1620-1630 m.
IUCN assessment: Near Threatened.



Palaina (s. l.) *novoguineensis* E.A. Smith, 1897
Distribution: Onin Peninsula & Bird's Neck Isthmus (W New Guinea), Misool Island (Raja Ampat Islands).
Endemism: endemic of the Papuan Region.
Number of localities: 1 (pre-1990), 3 (post-1990).
Habitat: primary lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *novopommerana* I. et B. Rensch, 1929
= *Palaina vexator* I. et B. Rensch, 1929 syn. nov.
Distribution: New Britain Island (Bismarck Archipelago).
Endemism: geographical & regional endemic.
Number of localities: 5 (pre-1990), 1 (post-1990).
Habitat: secondary lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *obiensis* sp. nov.
Distribution: Obira Island, Obi Islands (North Moluccas).
Endemism: geographical, regional & local endemic.
Number of localities: 2 (post-1990).
Habitat: primary & secondary lowland rainforests, gardens.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *onin* sp. nov.
Distribution: Onin Peninsula (W New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *papuamontis* sp. nov.
Distribution: Central Cordillera (Central New Guinea).
Endemism: geographical & regional endemic, ? local endemic.
Number of localities: 2 (post-1990).
Habitat: mid montane rainforests.
Altitude zone: 2050-2200 m.
IUCN assessment: Near Threatened.

Palaina (s. l.) *papuanorum* Soós, 1911
Distribution: West Sepik & Morobe provinces (N & NE New Guinea).
Endemism: geographical & regional endemic.
Number of localities: 2 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: unknown.
IUCN assessment: Data Deficient.

Palaina (s. l.) *paradisaea* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? local

endemic.
Number of localities: 2 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *perspectiva* sp. nov.
Distribution: southern lowlands of Doberai Peninsula (W New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Near Threatened.

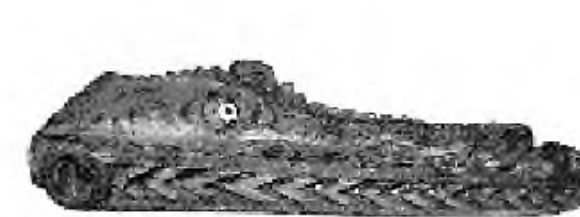
Palaina (s. l.) *polystoma* B. Rensch, 1931
Distribution: Flores Island (Lesser Sunda Islands).
Endemism: geographical & regional endemic.
Number of localities: 1 (pre-1990), 3 (post-1990).
Habitat: primary lowland to mid montane rainforests.
Altitude zone: up to 2200 m.
IUCN assessment: Endangered.

Palaina (s. l.) *ponsonbyi* Sykes, 1903
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 1 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *propinqua* van Benthem Jutting, 1963
Distribution: Biak & Yapen islands (Cenderawasih Bay Islands).
Endemism: geographical & regional endemic.
Number of localities: 2 (pre-1990), 0 (post-1990).
Habitat: sago swamp.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *psittricha* sp. nov.
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *quadricornis* van Benthem Jutting, 1958
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.



Palaina (s. l.) *repandostoma* van Benthem Jutting, 1963
Distribution: Biak Island (Cenderawasih Bay Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *scaevola* van Benthem Jutting, 1958
Distribution: Misool Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *silvicultrix* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical, regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *schneideri* I. et B. Rensch, 1929
Distribution: New Britain Island (Bismarck Archipelago).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 2 (pre-1990), 0 (post-1990).
Habitat: riverine lowland rainforests.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *slapcinskyi* sp. nov.
Distribution: Torricelli Mountains (N New Guinea).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 2 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Least Concern.

Palaina (s. l.) *solomonensis* (Dell, 1955) comb. nov.
Distribution: Mono Island (Solomon Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (pre-1990), 0 (post-1990).
Habitat: lowland rainforest.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *sparselamellata* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).
Habitat: primary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *tanimbarensis* sp. nov.
Distribution: Yamdena Island (Tanimbar Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *telnovi* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 2 (post-1990).
Habitat: secondary lowland rainforest on limestone.
Altitude zone: lowlands.
IUCN assessment: Endangered.

Palaina (s. l.) *thomasrinteleni* sp. nov.
Distribution: Yamdena Island (Tanimbar Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: primary lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *vermeuleni* sp. nov.
Distribution: Kobroor Island (Aru Islands).
Endemism: geographical & regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *waigeo* sp. nov.
Distribution: Waigeo Island, Wayag Island (Raja Ampat Islands).
Endemism: geographical & regional endemic.
Number of localities: 1 (post-1990).
Habitat: lowland rainforests on limestone.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.

Palaina (s. l.) *wawiyai* sp. nov.
Distribution: Waigeo Island (Raja Ampat Islands).
Endemism: geographical, regional endemic, ? site endemic.
Number of localities: 1 (post-1990).
Habitat: unknown.
Altitude zone: lowlands.
IUCN assessment: Data Deficient.



Palaina (s. l.) *wisemani* (Cox, 1870)

Distribution: Makira (= San Cristobal) & Owaraha (= Santa Anna) islands (Solomon Islands).

Endemism: geographical & regional endemic.

Number of localities: 2 (post-1990).

Habitat: unknown.

Altitude zone: montane areas.

IUCN assessment: Data Deficient.

Palaina (s. l.) *yamdena* sp. nov.

Distribution: Yamdena Island (Tanimbar Islands).

Endemism: geographical & regional endemic, ? site endemic.

Number of localities: 1 (post-1990).

Habitat: primary lowland rainforests on limestone.

Altitude zone: lowlands.

IUCN assessment: Data Deficient.

Chirality

As stated by Clements et al. (2008) and other authors, gastropod shells generally exhibit logarithmic spiral growth, coiling, usually dextrally around a single axis. The shell is secreted by the mantle edge, a soft elastic sheet of connective tissue covered by an epithelium (Wilbur 1964). Thus, a shell is essentially a petrified ontogeny of the aperture (the mantle edge) (Liew et al. 2014). Most of molluscs groups possess dextrally coiled shells. Several snail groups including the Diplommatinidae have both dextral and sinistral shells. Many diplommatinids are sinistral (especially those of *Palaina* O. Semper, 1865 where the majority of species are). Moreover, the Diplommatinidae have a third, unique chiral form, termed sinistroid, previously found only in the Oriental genus *Opisthosoma* Blanford et Blanford, 1860 (Clements et al. 2008; Webster et al. 2012). Sinistroid species start out dextrally coiling and reverse coiling direction during ontogeny forming a sinistral tuba on a dextral shell.

A particularly unusual species from the Raja Ampat Islands offshore of W New Guinea has one of the most uniquely coiled shells among all known molluscs. This species is placed in the genus *Moussonina* O. Semper, 1865³. In this species (see description of *M. monstificabilis* sp. nov. above) the first five whorls are dextral forming a broadly triangular shell. On the 5th whorl the shell's coiling direction is reversed resulting in what looks like a sinis-

3 Phylogenetic information is not available for other *Moussonina* species, as a result, my placement of aforementioned species into this genus is based exclusively on conchological characters. Phylogenetically *M. monstificabilis* sp. nov. is closely related to Papuan *M. separanda* sp. nov.

tral shell (sinistroid shell). The sinistral tuba (the whorls after the reversal in coiling direction) completely overgrows and obscures the initially dextral shell (Plate 29 figs 1-8). Since it was not possible to study the anatomy (e.g. radula) of this species because of a lack of technical equipment, it is not impossible *M. monstificabilis* sp. nov. and its relatives represent a new (undescribed) genus as follows from their isolated position on a phylogenetic tree of caenogastropods (see the chapter "Phylogeny" below).

Among all known Diplommatinidae of the Papuan Region and Wallacea *Palaina* (s. l.) *angulata* O. Boettger, 1891 is the only species known to have both dextral (prevalently) and sinistral (two specimens from Saparua Island, Lease Islands) shells.

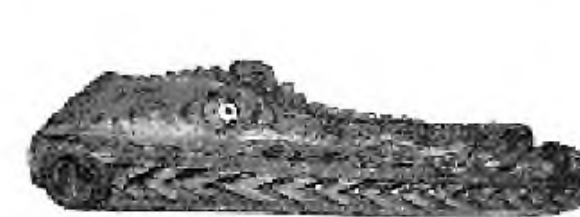
A comparison of chiral diversity of the diplommatinids in this study summarized on Fig. 7 (also consider tables 4-5, 7, 9 & 11). Generally, all *Arinia* in the study area are dextral (see note above about unclear status of this genus), all *Diancta* are sinistral, *Diplommatina* is 68% dextral and 32% sinistral, *Moussonina* are all dextral with one sinistroid species (8%), finally *Palaina* is predominantly sinistral (78%) with 22% dextral species and one dextral species with sinistral specimens. The case of *Palaina* is rather unique within molluscs since few other prevalently sinistral large groups are known. The reason why exactly this genus is so rich in sinistral species remains unknown.

Phylogeny

Originally, my work has no goal to provide DNA-based phylogenetic reconstruction. However, since alcohol-preserved material allowed DNA sequencing, some additional information was available to include to the present revision and is presented below.

The first molecular phylogenetic reconstruction of the Diplommatinidae was undertaken by Webster et al. (2012) and based on five genes and 2700 bp. It was integrated with ancestral state reconstruction and phylogenetic PCA of discrete and quantitative traits. Webster et al. (2012) found support for the SE Asian Diplommatinidae as a monophyletic group and raised the rank of the Cochlostomatidae as a family. According to his study, five main clades appear within the Diplommatinidae, corresponding with both coiling direction and biogeographic patterns.

Relations between Lesser Sunda and Central Moluccan species is rather obvious (*Palaina an-*



gulata, *P. ascendens*, *P. manggaraica*) since these species represent same clade.

Clade E of Webster (2012) in the study area represented at least by *Diplommatina baliana*, a species from Java and W Lesser Sunda Islands.

Raja Ampat Islands species *Palaina attenboroughi*, *P. bicornis*, *P. hartmanni*, *P. megalostoma* are representing at least three clusters, one for species from Waigeo and two - for species from Misool.

Diancta constricta demonstrates phylogenetic distance of North Moluccan clade.

The most peculiar is the relationship of two species from Misool I currently arranged to *Moussonia* - *M. monstificabilis* and *M. separanda*. Results show position of these two species either closely related to Alycaeinae of the Cochlostomatidae rather than to any known Diplommatinidae. At this point, I am not able to explain their position within the tree of Caenogastropoda. COI is a relatively rapidly evolving gene and while it is often good for elucidating species level relationships it is not that good at older divergences and it is likely the deeper level relationships may not be accurate (J. Slapcinsky, personal comment). In the future adding some more slowly evolving genes might resolve some of the deeper level nodes in the Diplommatinidae tree.

Arinia, *Diancta*, *Diplommatina*, *Moussonia*, and *Palaina* require revision to allow taxonomy to reflect phylogeny. Additional sequencing is highly welcome to clarify biogeographic patterns of newly appearing clades.

Sexual dimorphism

Diplommatinidae, like other caenogastropods have separate sexes that can be sexually dimorphic. Ribbing pattern and colour variation vary among specimens of both sexes and not specifically in males or females. Female shells are generally more obese than those of males (Figs 98 & 105a-b), but these size differences are slight and not measurable in mm scale but in µm. For example, in *Palaina iha*, female is 300 µm wider than male and in *P. lengguru*, females are 250-350 µm wider than males.

Acknowledgements

The author is highly grateful to Jonathan Ablett (BMNH), Adam Baldinger and Jennifer W. Lenihan (both at MCZ), Jochen Gerber (FMNH), Jeroen Goud and Auke-Florian Hiemstra (NMNL), Ambros Hänggi and Eduard Stöckli (both at NHMB), Ronald Janssen and Sigrid Hof (SMF), Jolanta Jurkowska (UWCP), Taehwan Lee (UMMZ), Henry McGhie (MMUE), Tan Siong Kiat (LKCNHM), Bruce Marshall and Ricardo Palma (both at MONZ), Jude Philp (Sydney University Museum, Australia), Thomas von Rintelen and Christine Zorn (both at MHUB), John Slapcinsky (UF), Maria Tavano (MSNG), and Jan J. Vermeulen (Leiden, The Netherlands) for access to type material and other collection material, as well as for providing photographs of certain type specimens.

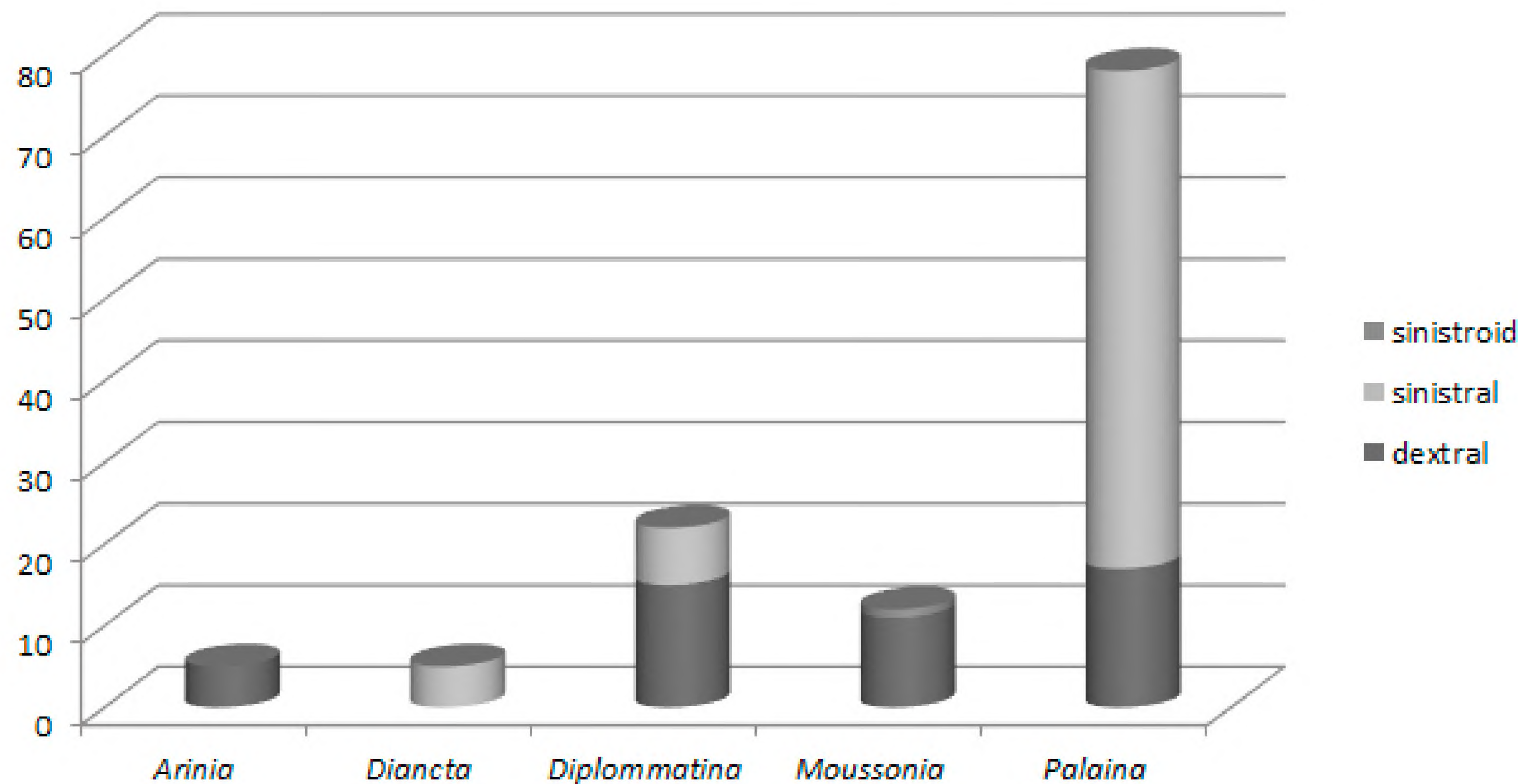


Figure 7. Chiral diversity among the Wallacean and Papuan Diplommatinidae.
Legends: x axis - Diplommatinidae genera, y axis - number of species.



Christian Albrecht (Justus-Liebig-University Giessen, Department of Animal Ecology & Systematics, Germany) is thanked for arranging DNA sequencing and consulting on phylogenetic reconstruction of the Diplommatinidae.

The author is thankful to Valters Gobiņš (University of Latvia Faculty of Biology, Department of Molecular Biology, Rīga) for generous help on preparation of specimen shells before SEM procedures at the Laboratory of microscopy. I am also grateful to Uģis Kagainis (University of Latvia Faculty of Biology, Department of Zoology and Animal Ecology, Rīga) for producing the scanning electron micrographs.

Dmitry Telnov (The Entomological Society of Latvia, Rīga) is herewith thanked for preparing photographs of specimens as well as for valuable information on habitat of many species from the study area, as well for providing preliminary IUCN assessments. I am also grateful to Laszlo Wagner (Budapest, Hungary) for providing valuable specimens from study area.

The author is indebted to Roman V. Egorov (Moscow, Russia) for valuable consultations. Finally, I sincerely thank John Slapcinsky (UF) for proof-reading the manuscript, friendly critics and valuable suggestions.

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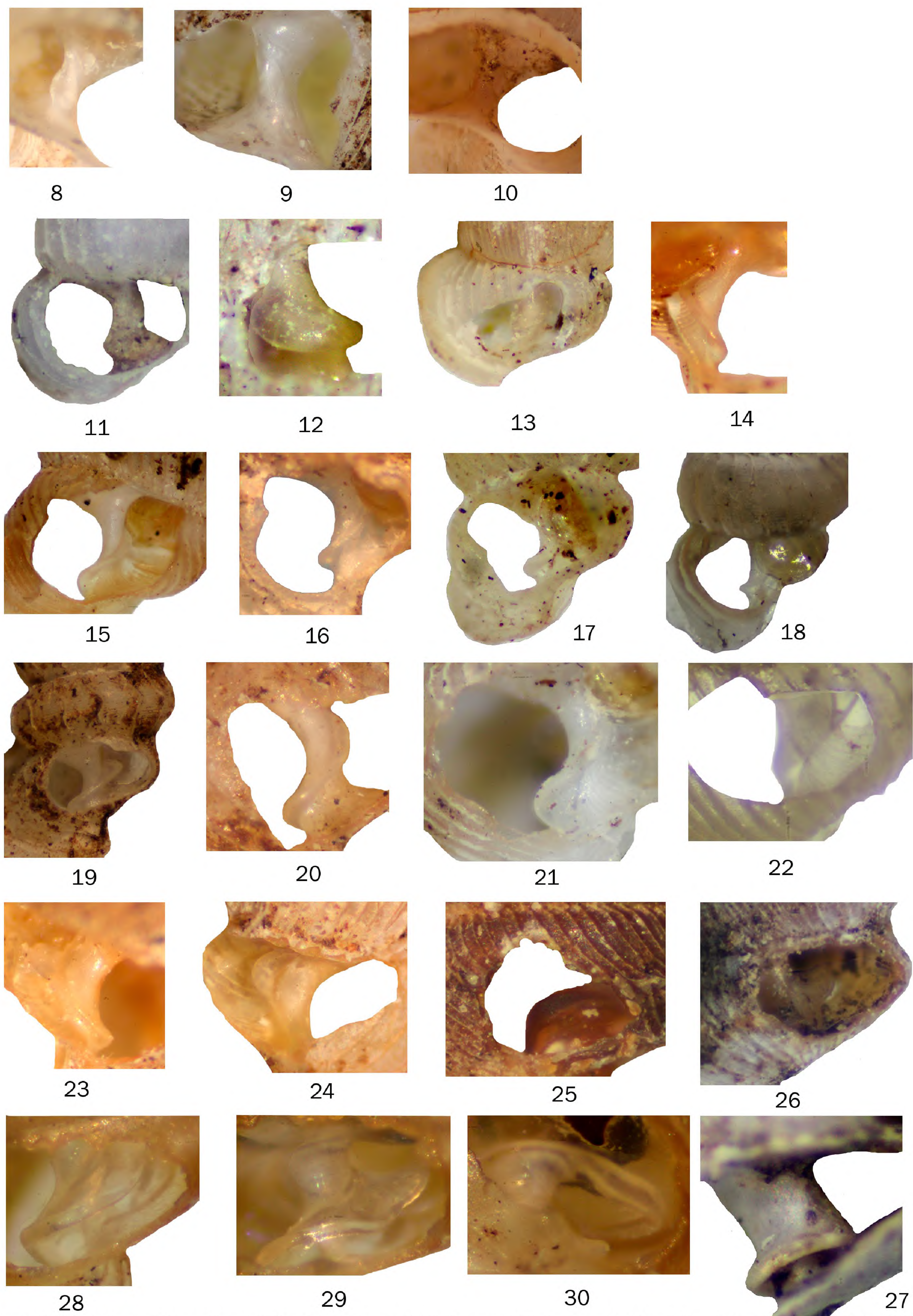
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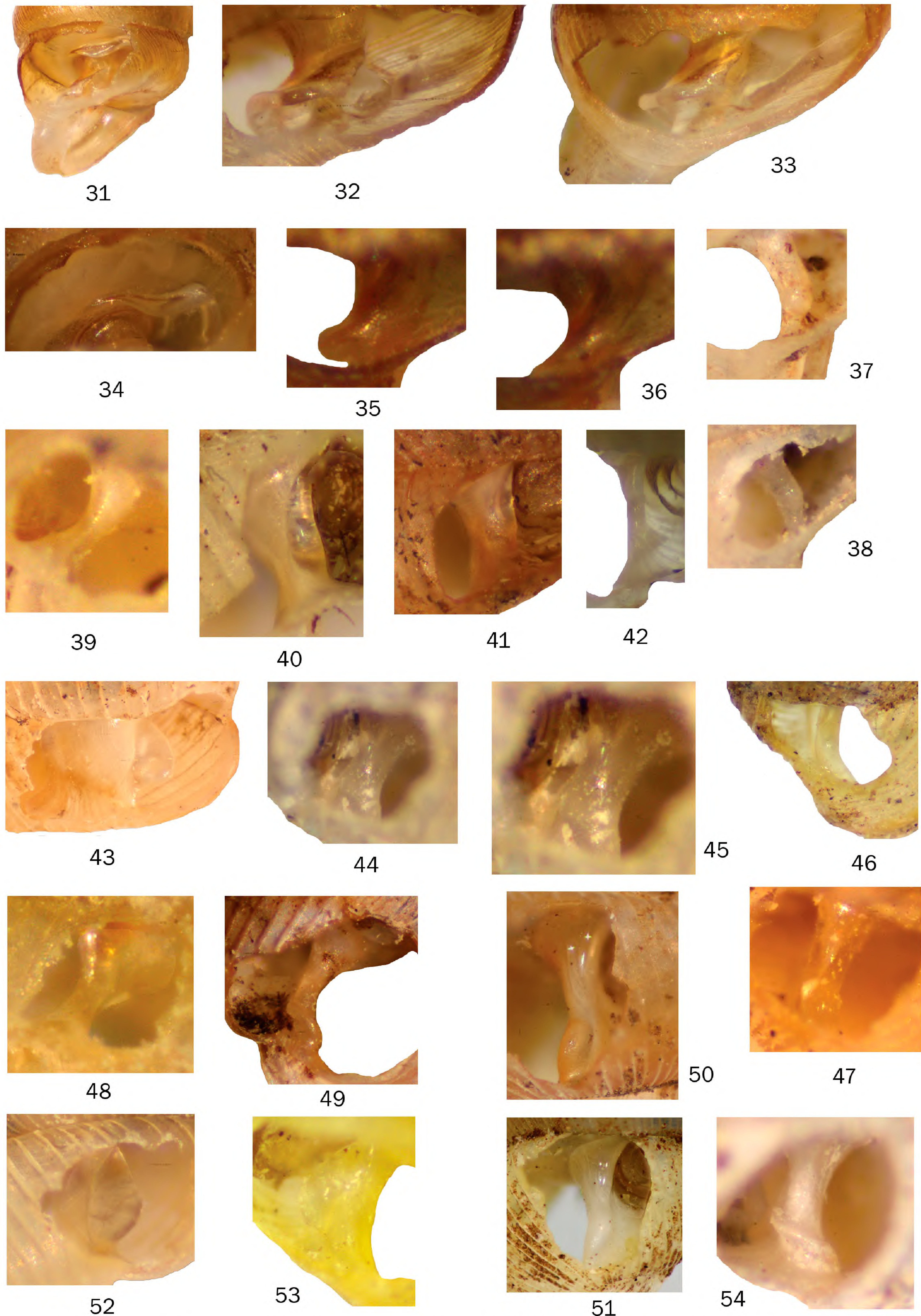
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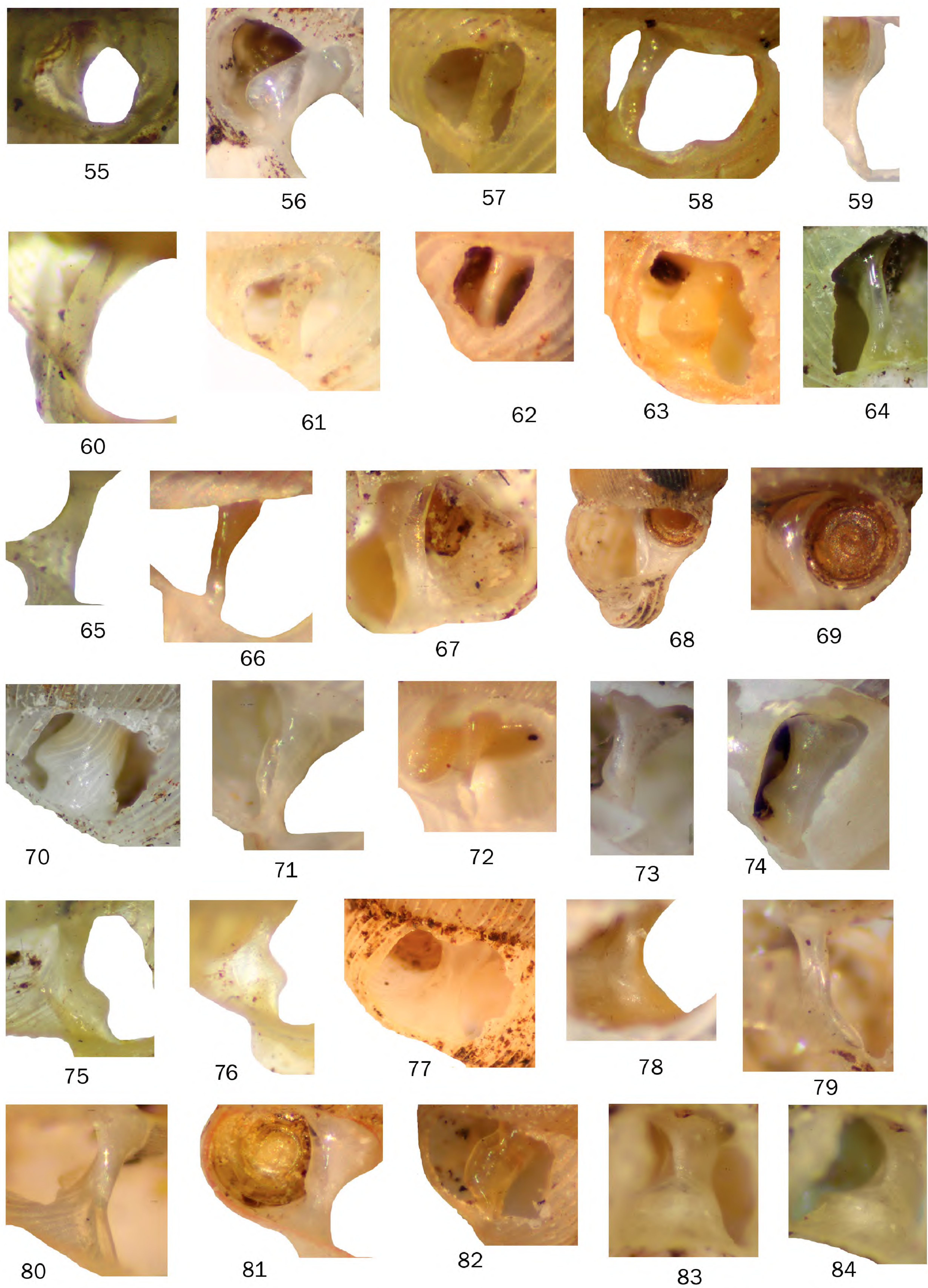
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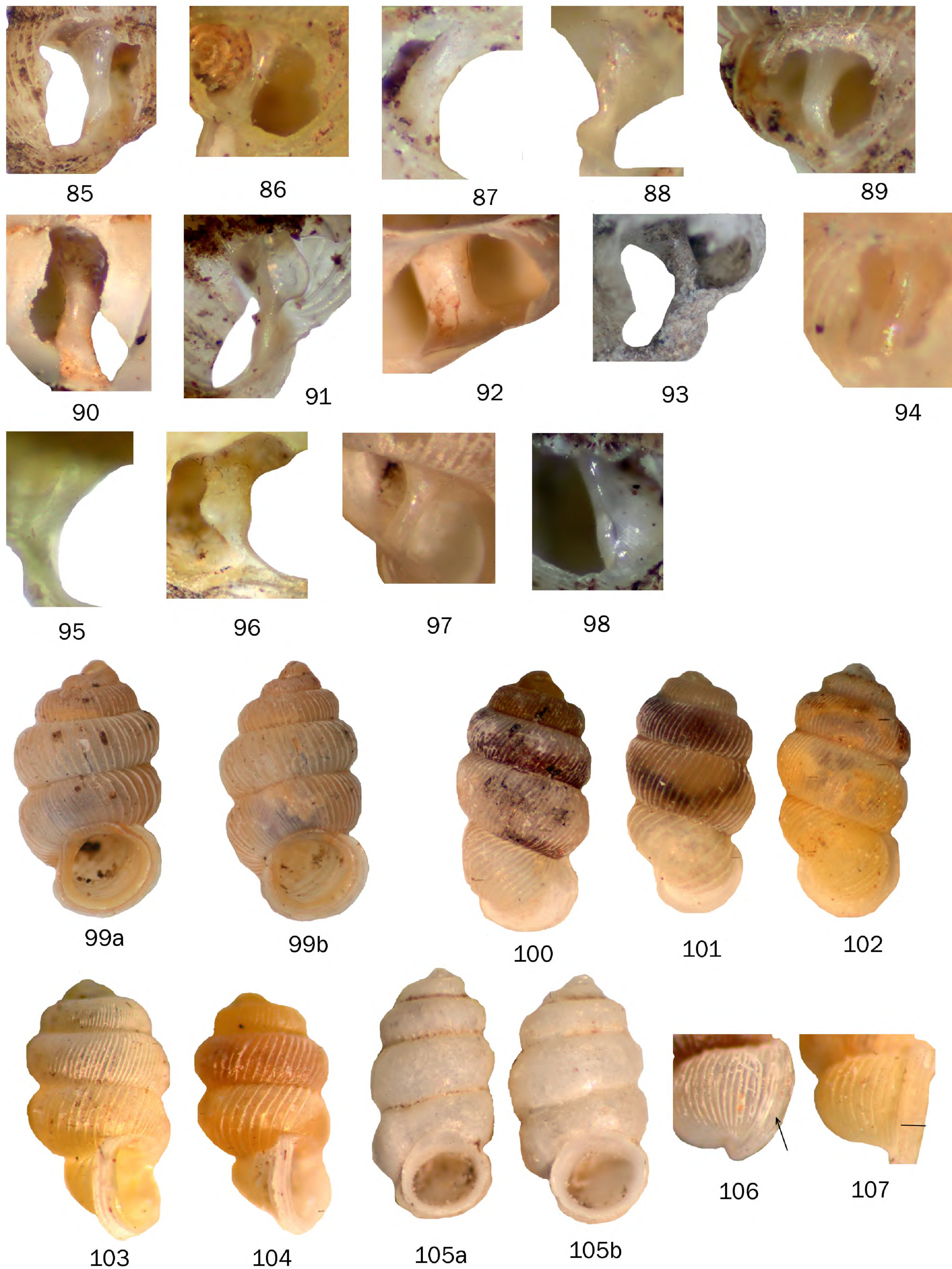
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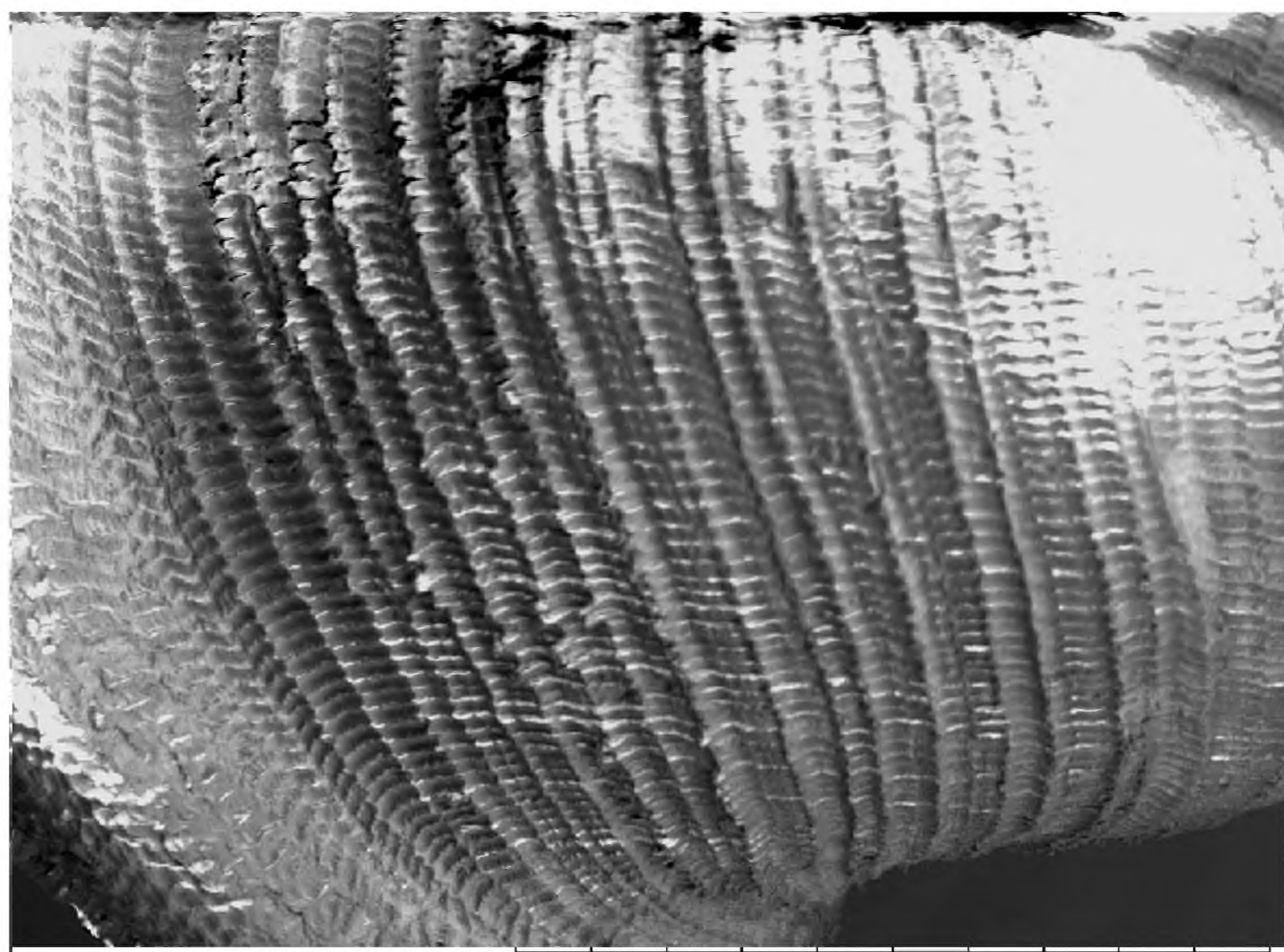
Figures 55-84. Internal lamellae and opercula of the Papuan and Wallacean Diplommatinidae. 55 – *Palaina dohertyi* E.A. Smith, 1897; 56 – *P. extrema* sp. nov.; 57 – *P. flavocylindrica* sp. nov.; 58 – *P. hartmanni* sp. nov.; 59 – *P. lousiade* sp. nov.; 60 – *P. iha* sp. nov.; 61 – *P. imperfecta* sp. nov.; 62 – *P. insulana* sp. nov.; 63 – *P. laszloi* sp. nov.; 64 – *P. novoguineensis* E.A. Smith, 1897; 65-66 – *P. lengguru* sp. nov.; 67 – *P. mairasi* sp. nov.; 68-69 – *P. mang-garaica* (E.A. Smith, 1897); 70 – *P. megalostoma* sp. nov.; 71 – *P. mengen* sp. nov.; 72 – *P. minuscularia* sp. nov.; 73-74 – *P. mirifica* sp. nov.; 75-76 – *P. misoolensis* sp. nov.; 77 – *P. mutis* sp. nov.; 78 – *P. novopommerana* I. et B. Rensch, 1929; 79 – *P. obiensis* sp. nov.; 80 – *P. onin* sp. nov.; 81 – *P. papuamontis* sp. nov.; 82 – *P. paradisaea* sp. nov.; 83-84 – *P. perspectiva* sp. nov..





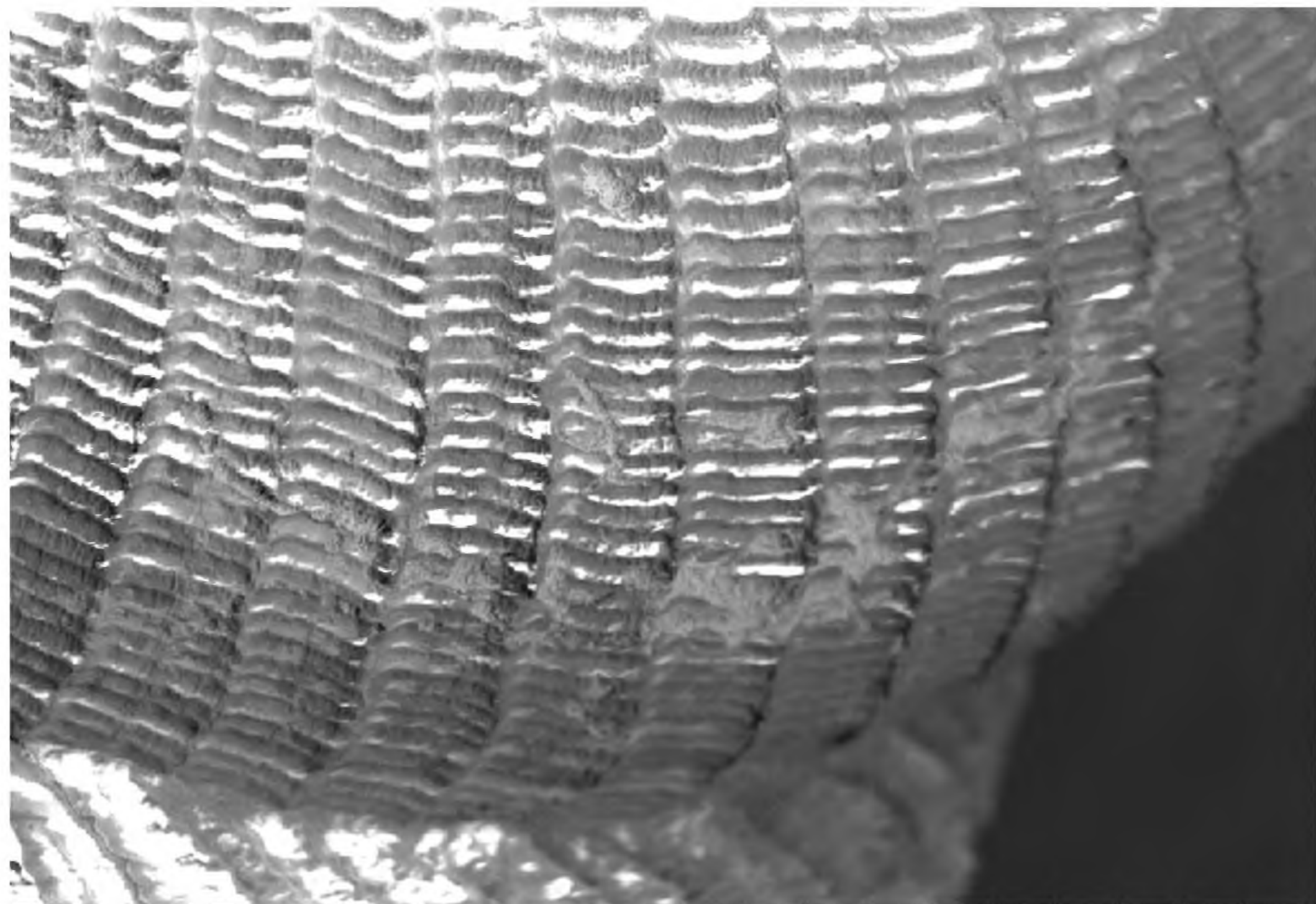
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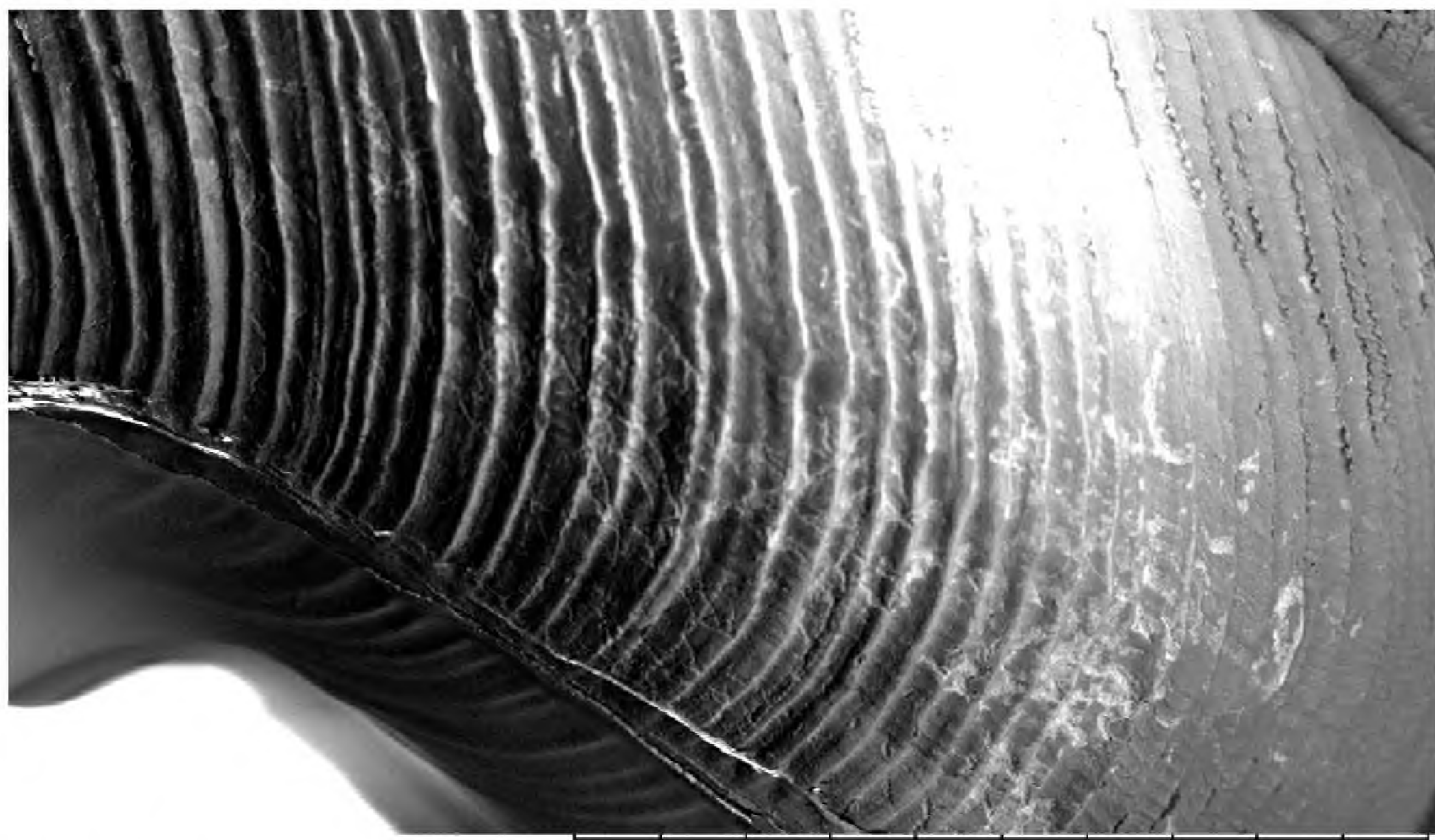
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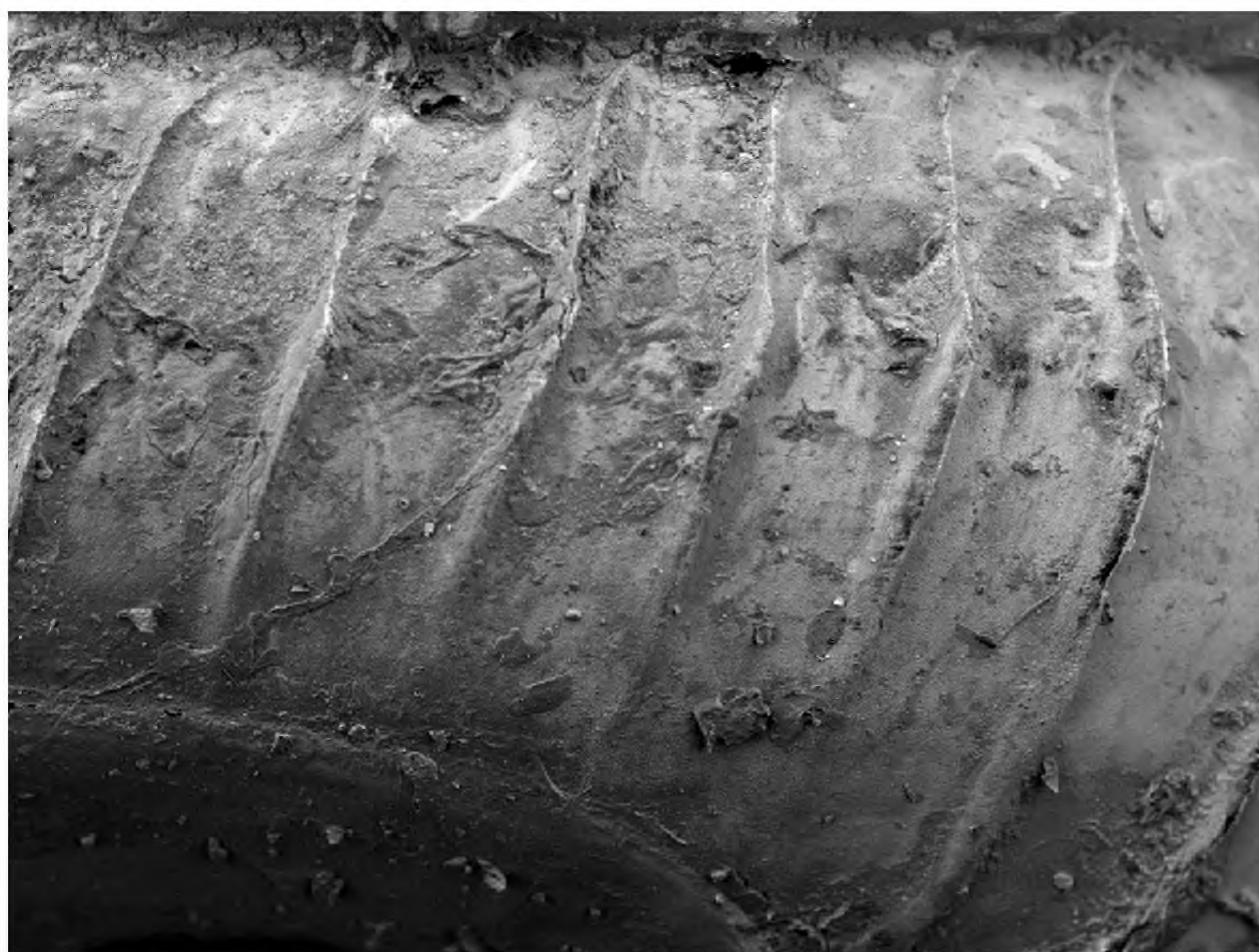
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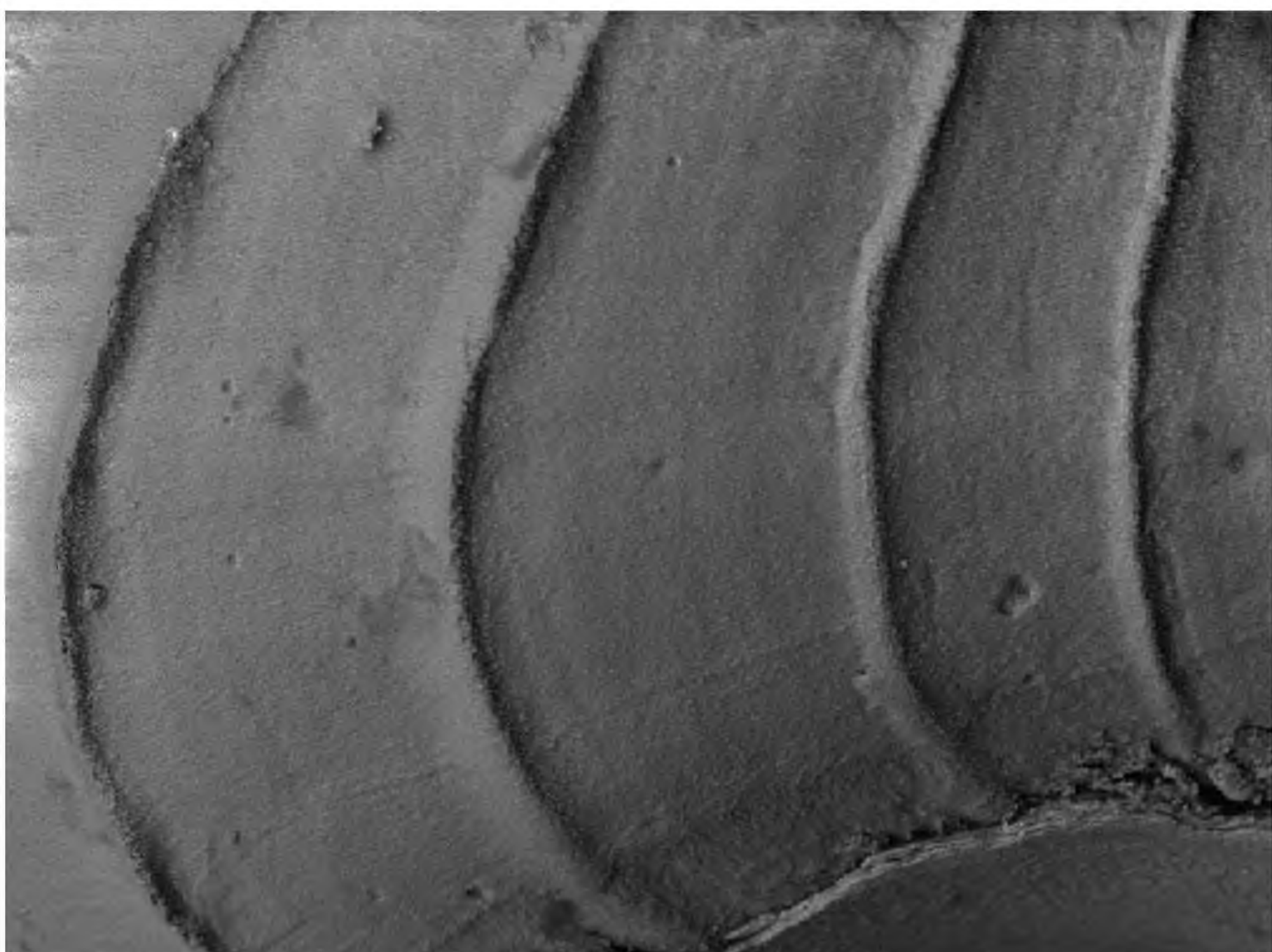
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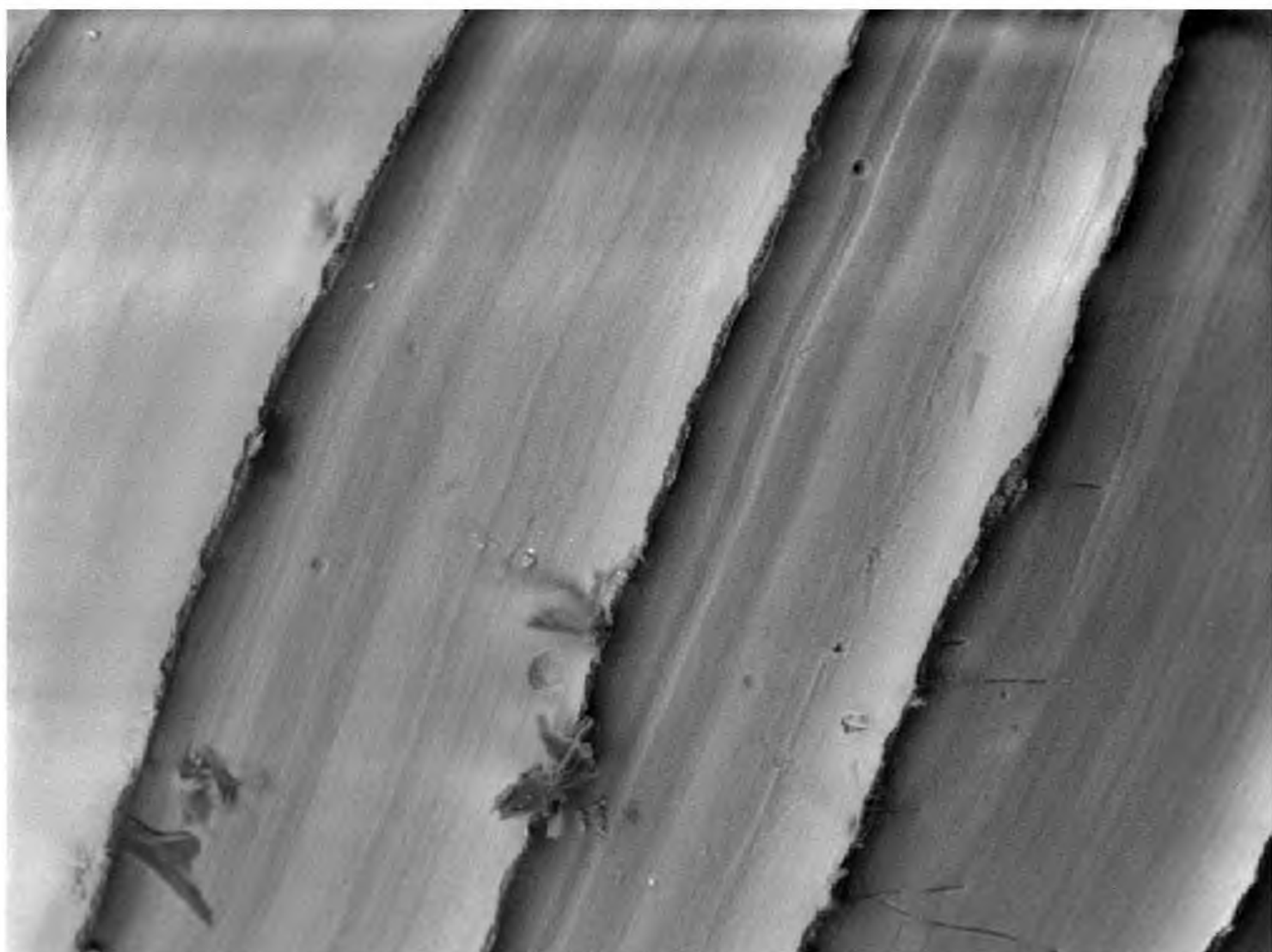
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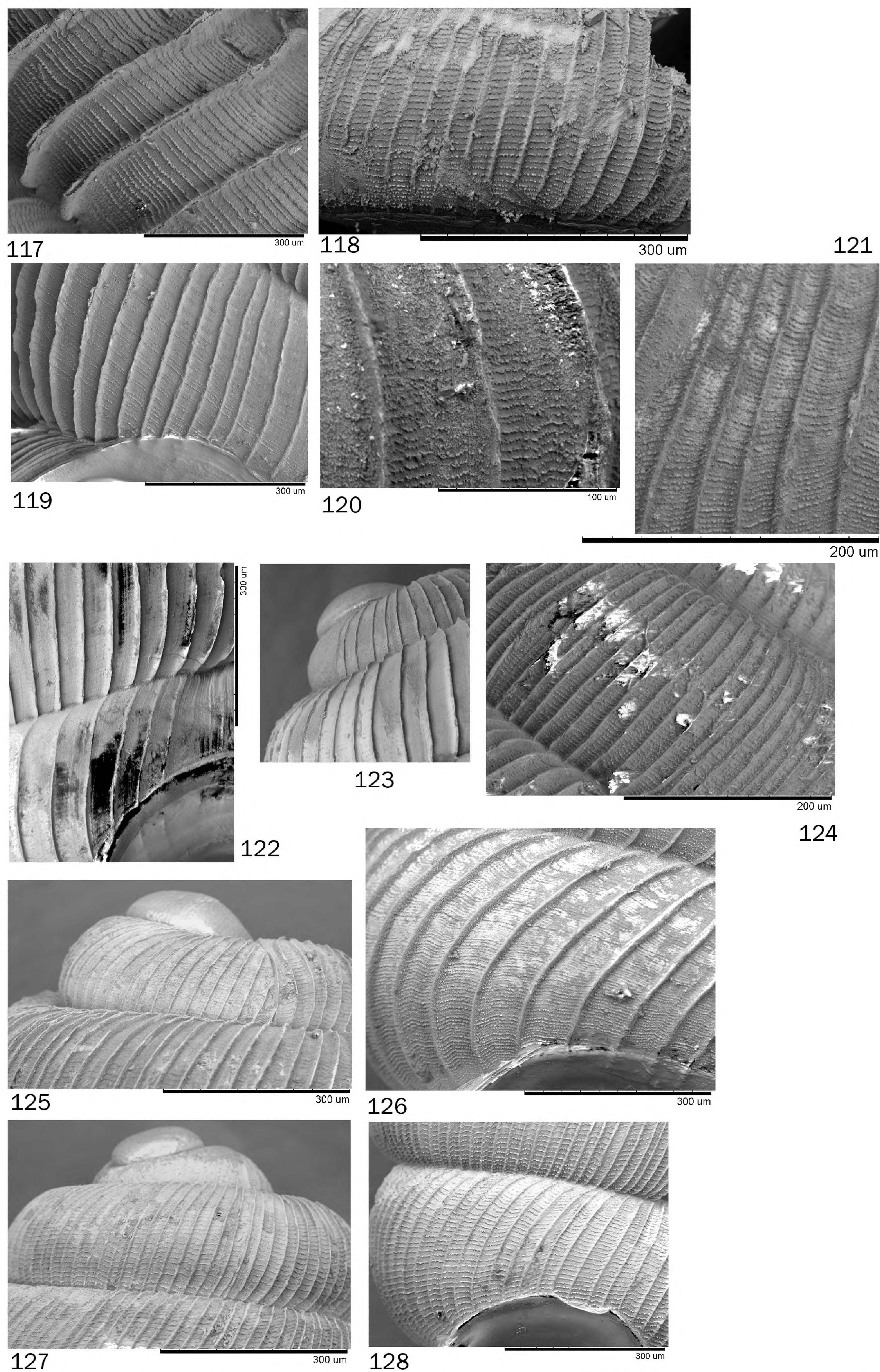


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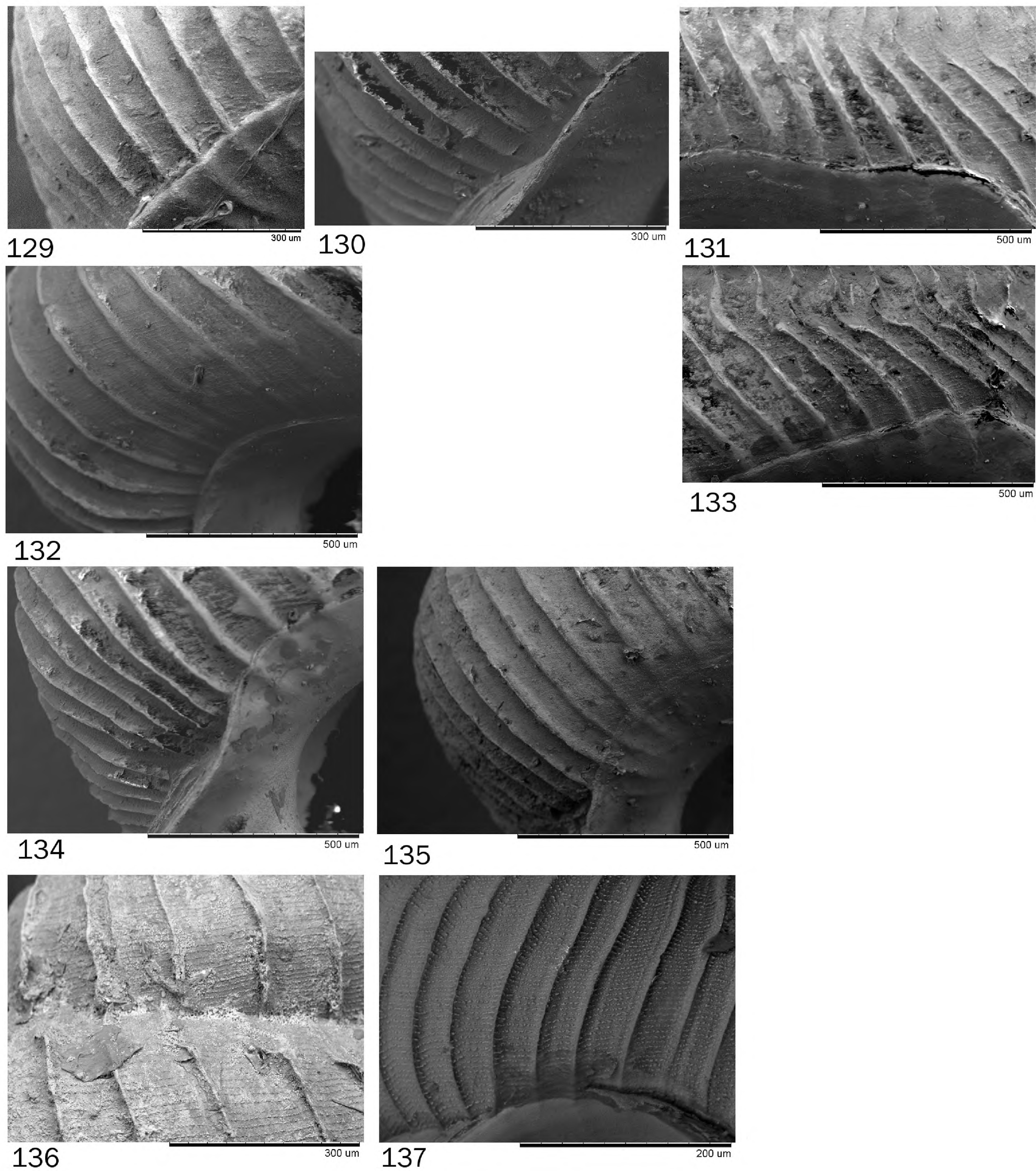
Figures 108-116. Micrographs of the Papuan and Wallacean Diplommatinidae. 108-109 – *Moussonia monstrificabilis* sp. nov. (200x & 400x magnification); 110 – *M. separanda* sp. nov. (200x); 111 – *Diplommatina radiiformis* Preston, 1913 (300x); 112 – *D. floresiana* E.A. Smith, 1897 (200x); 113 – *D. jonabletti* sp. nov. (200x); 114 – *Palaina angulata* O. Boettger, 1891 (300x); 115 – *P. silvicultrix* sp. nov. (300x); 116 – *P. wawiyai* sp. nov. (300x).





Figures 117-128. Micrographs of the Papuan and Wallacean Diplommatinidae. 117 – *Palaina attenboroughi* sp. nov. (300x magnification); 118 – *P. biroi* Soós, 1911 (300x); 119-120 – *P. carbavica* O. Boettger, 1891 (300x & 1000x); 121 – *P. flavocylindrica* sp. nov. (500x); 122-123 – *P. hartmanni* sp. nov. (300x); 124 – *Palaina iha* sp. nov. (500x); 125-126 – *P. insulana* sp. nov. (300x); 127-128 – *P. minuscularia* sp. nov. (300x).





Figures 129-137. Micrographs of the Papuan and Wallacean Diplommatinidae. 129-131 – *Diplommatina mertoni* C.R. Boettger, 1922 (300x magnification); 132-135 – *D. telnovi* sp. nov. (200x); 136 – *D. symmetrica* Hedley, 1891 (300x); 137 – *Palaina albrechti* sp. nov. (500x).





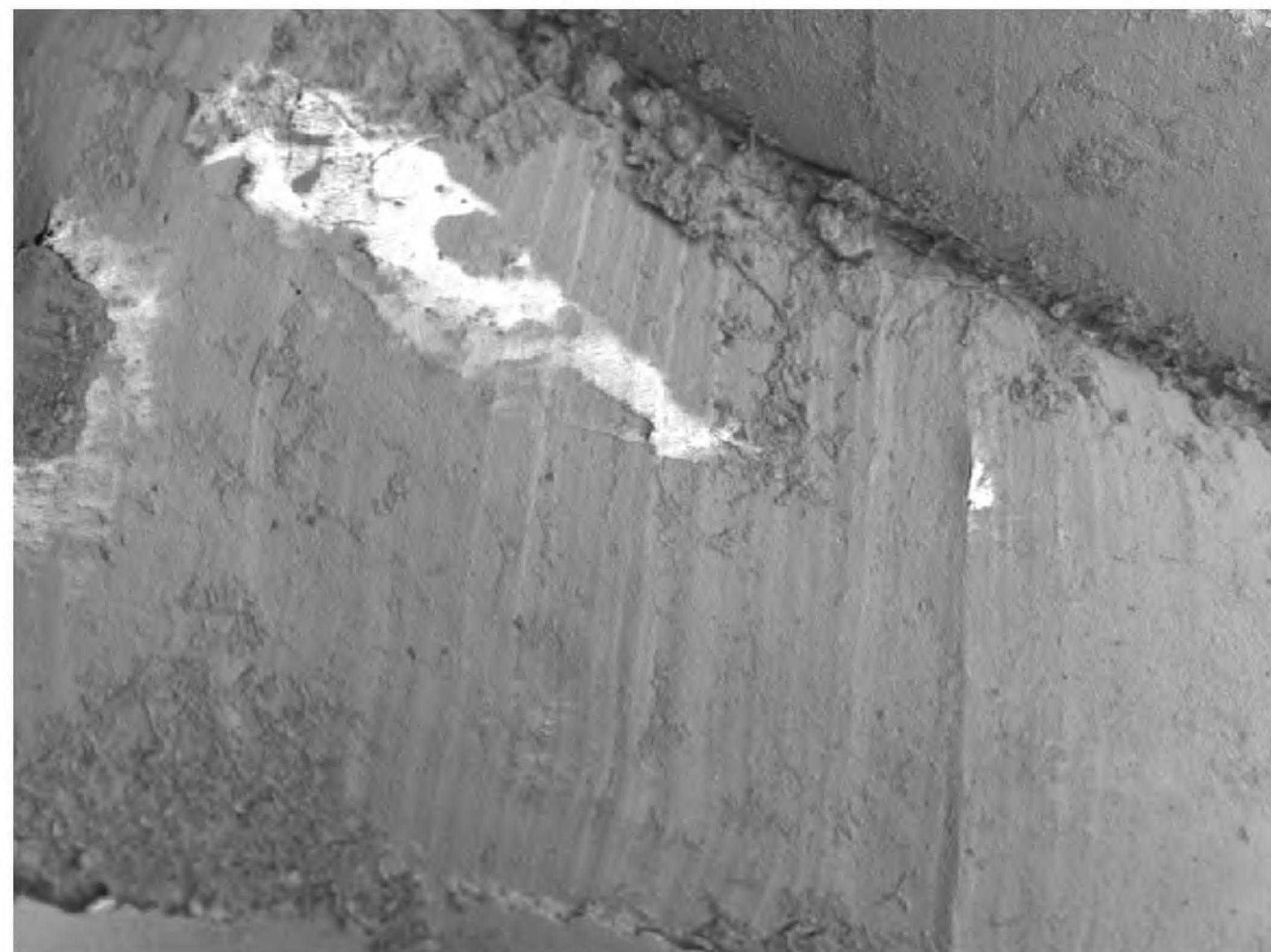
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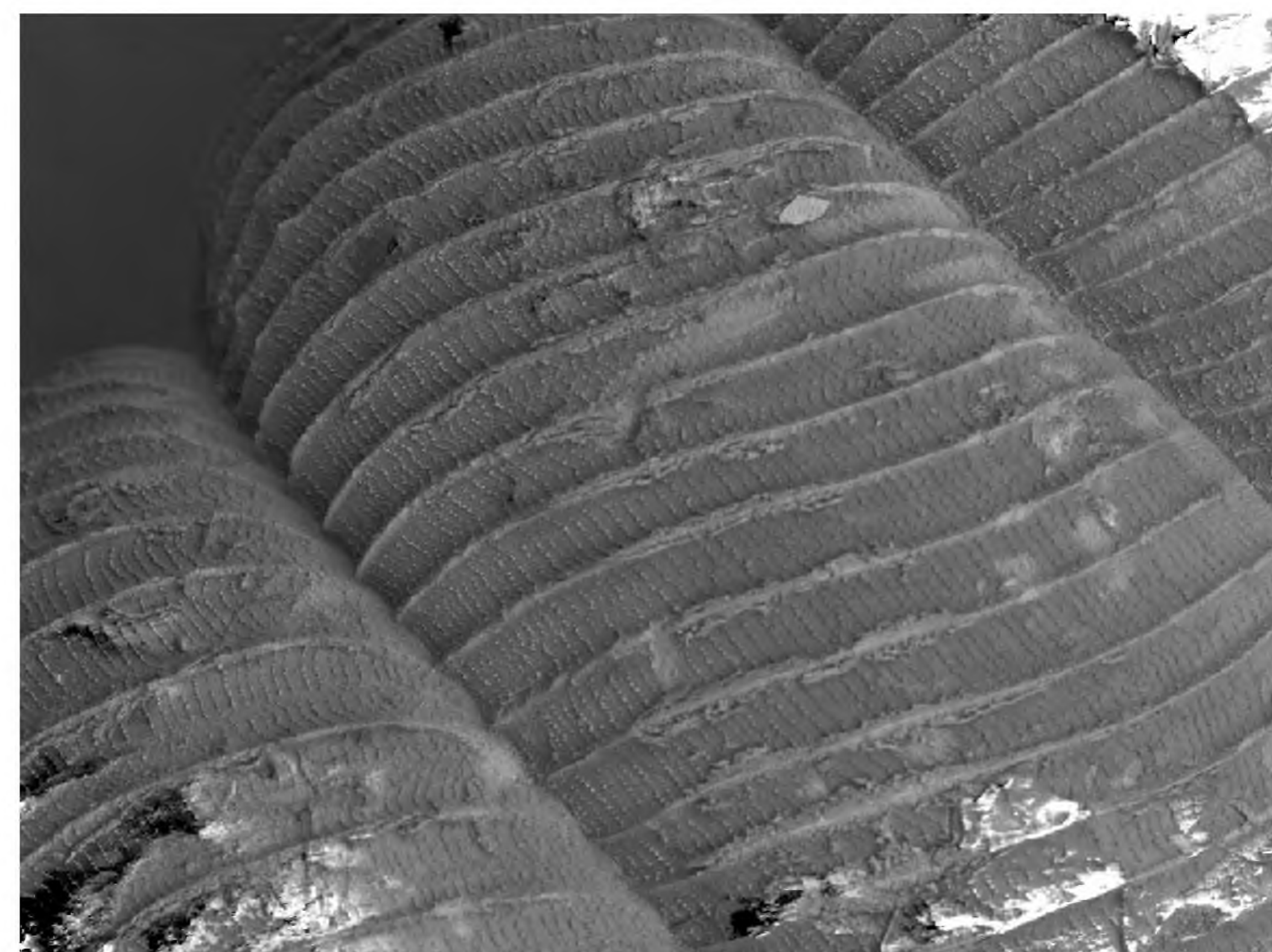
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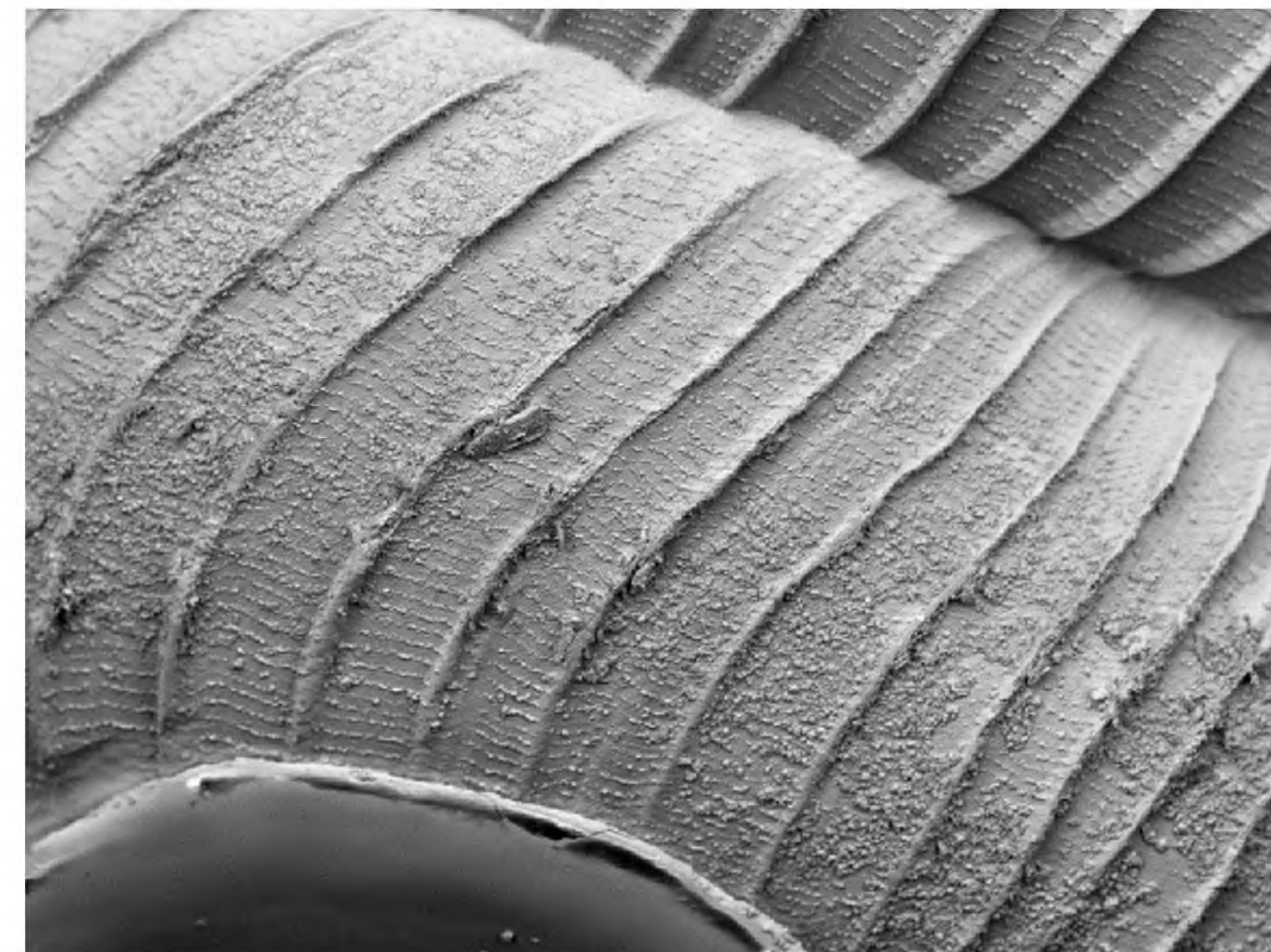
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Figures 138-145. Micrographs of the Papuan and Wallacean Diplommatinidae. 138-139 – *Palaina obiensis* sp. nov. (300x magnification); 140-141 – *Arinia tjendanae* B. Rensch, 1931 (300x); 142 – *P. psittricha* sp. nov. (300x); 143 – *P. waigeo* sp. nov. (300x); 144-145 – *P. yamdena* sp. nov. (300x).

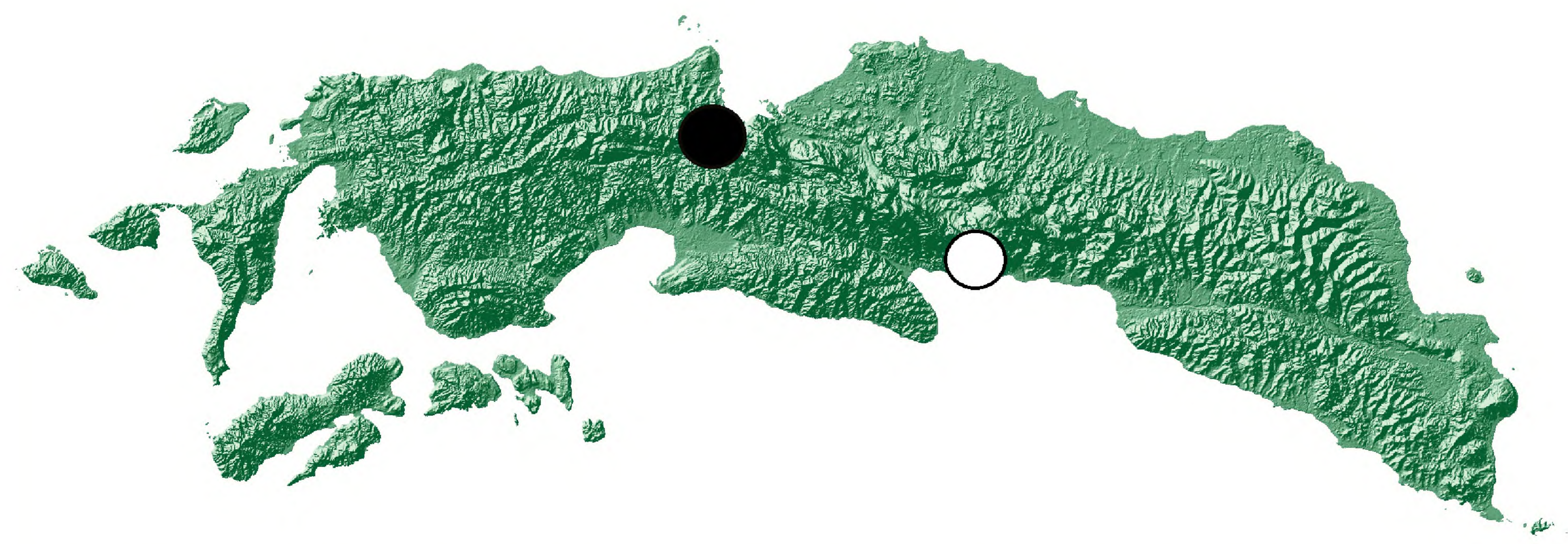




Map 5. Distribution of Diplommatinidae on North Moluccas. Circles – *Diancta* (s. str.) *constricta* (Martens, 1864); filled circles – *D.* (s. str.) *halmaherica* sp. nov.; squares – *D.* (s. str.) *obiensis* sp. nov.; filled square – *D.* (s. str.) *torta* O. Boettger, 1891; four-point star – *Diplommatina* (s. l.) *patani* sp. nov.; filled four-point stars – *D.* (s. l.) *radiiformis* Preston, 1913.

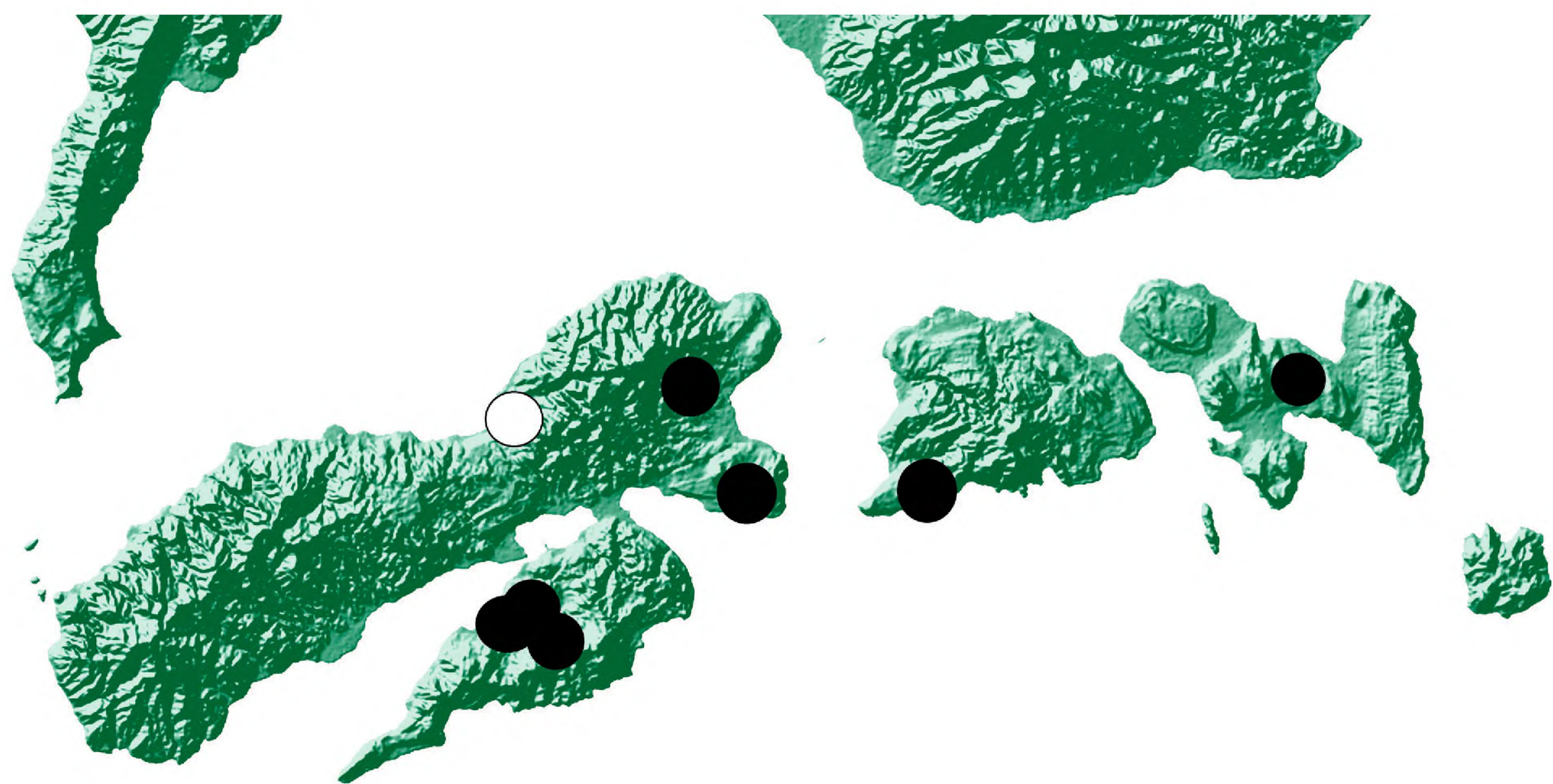


Map 6. Distribution of Diplommatinidae on North Moluccas. Circles – *Diplommatina* (s. l.) *moluccensis* sp. nov.; filled circle – *D.* (s. l.) *slapcinskyi* sp. nov. & *Palaina* (s. l.) *obiensis* sp. nov.; square – *P.* (s. l.) *minutula* sp. nov.; filled square – *Moussonia athena* (Preston, 1913), *Palaina* (s. l.) *beilanensis* Preston, 1913 & *P.* (s. str.) *diepenheimi* (Preston, 1913).

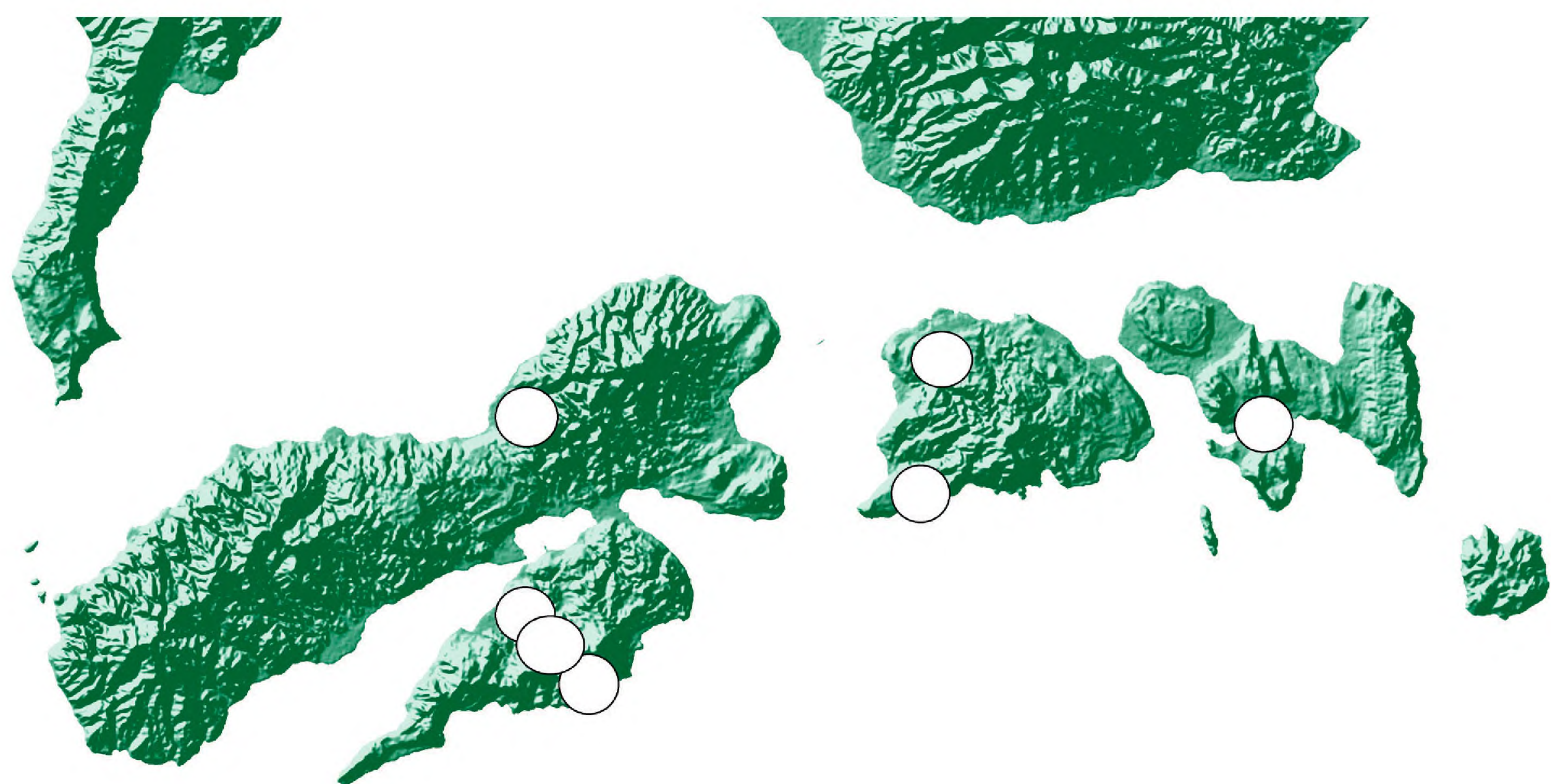


Map 7. Distribution of Diplommatinidae on Seram, Central Moluccas. Circles – *Moussonia manuselae* sp. nov.; filled circle – *Palaina* (s. l.) *carbavica* O. Boettger, 1891 (see also map 10).





Map 8. Distribution of Diplommatinidae on Lease Islands, Central Moluccas. Circle – *Moussonia strubelli* (O. Boettger, 1891); filled circles – *Palaina* (s. l.) *angulata* O. Boettger, 1891.



Map 9. Distribution of Diplommatinidae on Lease Islands, Central Moluccas. Circles – *Palaina* (s. l.) *ascendens* (Martens, 1864).





Map 10. Distribution of Diplommatinidae on Lease Islands, Central Moluccas. Circles – *Palaina* (s. l.) *carbavica* O. Boettger, 1891.



Map 11. Distribution of Diplommatinidae on Solomon Islands. Circle – *Palaina* (s. l.) *aerari* (Dell, 1955) (see also map 19), *P.* (s. l.) *clappi* Solem, 1960 & *P.* (s. l.) *floridensis* Solem, 1960; filled circle – *P.* (s. l.) *brazieri* (Cox, 1870); square – *P.* (s. l.) *gardneri* Dell, 1955; filled circle & filled square – *P.* (s. l.) *wisemani* (Cox, 1870).





Map 12. Distribution of Diplommatinidae on Lesser Sunda Islands. Circles – *Arinia* (s. l.) *crassiventris* B. Rensch, 1931; filled circle – *A.* (s. l.) *patagiata* van Benthem Jutting, 1958; circles & square – *A.* (s. l.) *tjendanae* B. Rensch, 1931 (see also map 15); filled squares – *Diplommatina* (s. l.) *floresiana* E.A. Smith, 1897; stars – *D.* (s. l.) *floris* B. Rensch, 1931; filled star – *D.* (s. l.) *torquilla* van Benthem Jutting, 1958; four-point star – *D.* (s. l.) *timorensis* sp. nov.

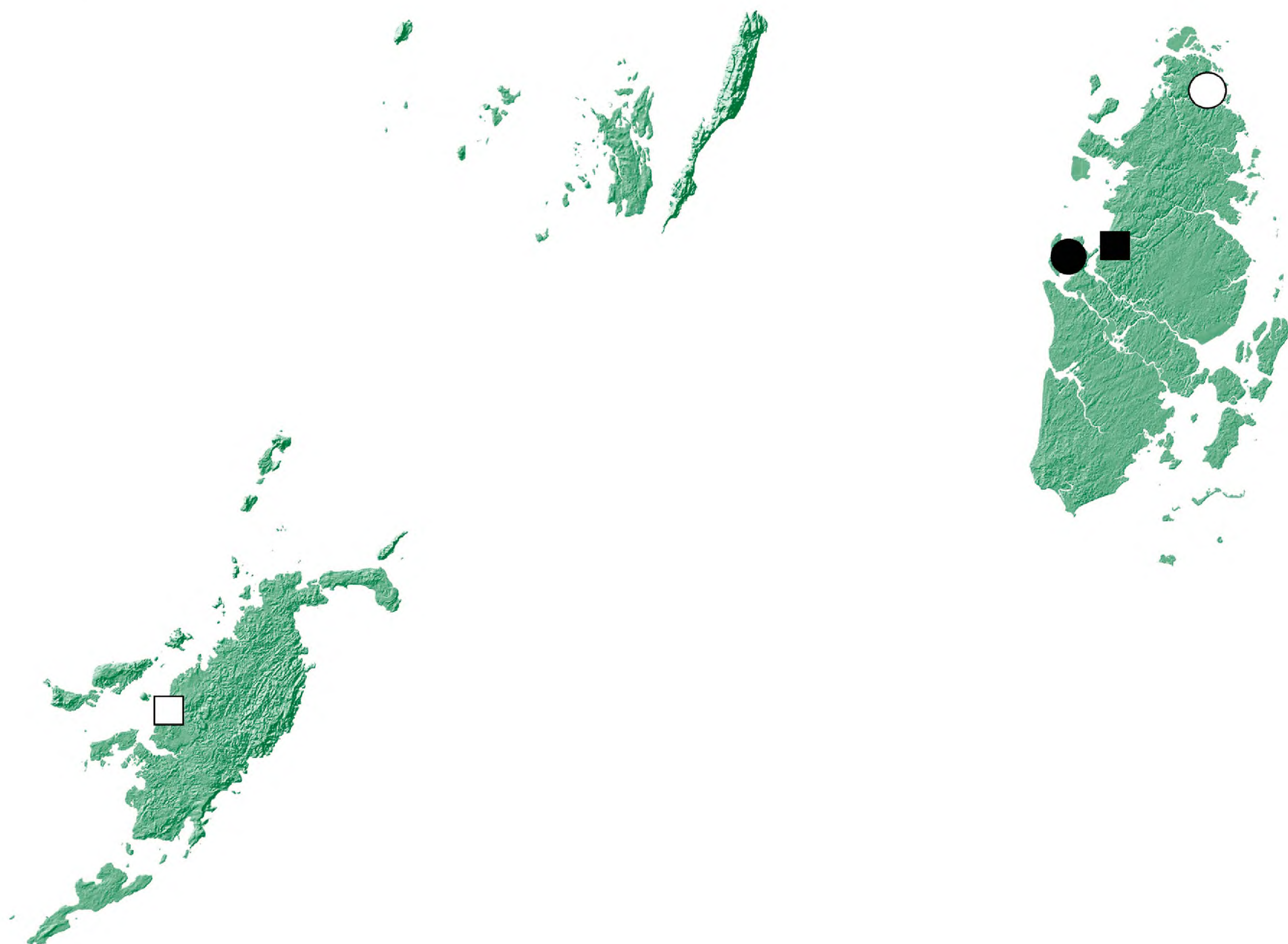


Map 13. Distribution of Diplommatinidae on Lesser Sunda Islands. Circles – *Diplommatina* (s. l.) *decollata* van Benthem Jutting, 1958; circles & filled circles – *D.* (s. l.) *fluminis* B. Rensch, 1931; squares – *D.* (s. l.) *javana* von Möllendorff, 1897; filled squares – *D.* (s. l.) *jonabletti* sp. nov. & *Palaina* (s. l.) *manggaraica* (B. Rensch, 1931).



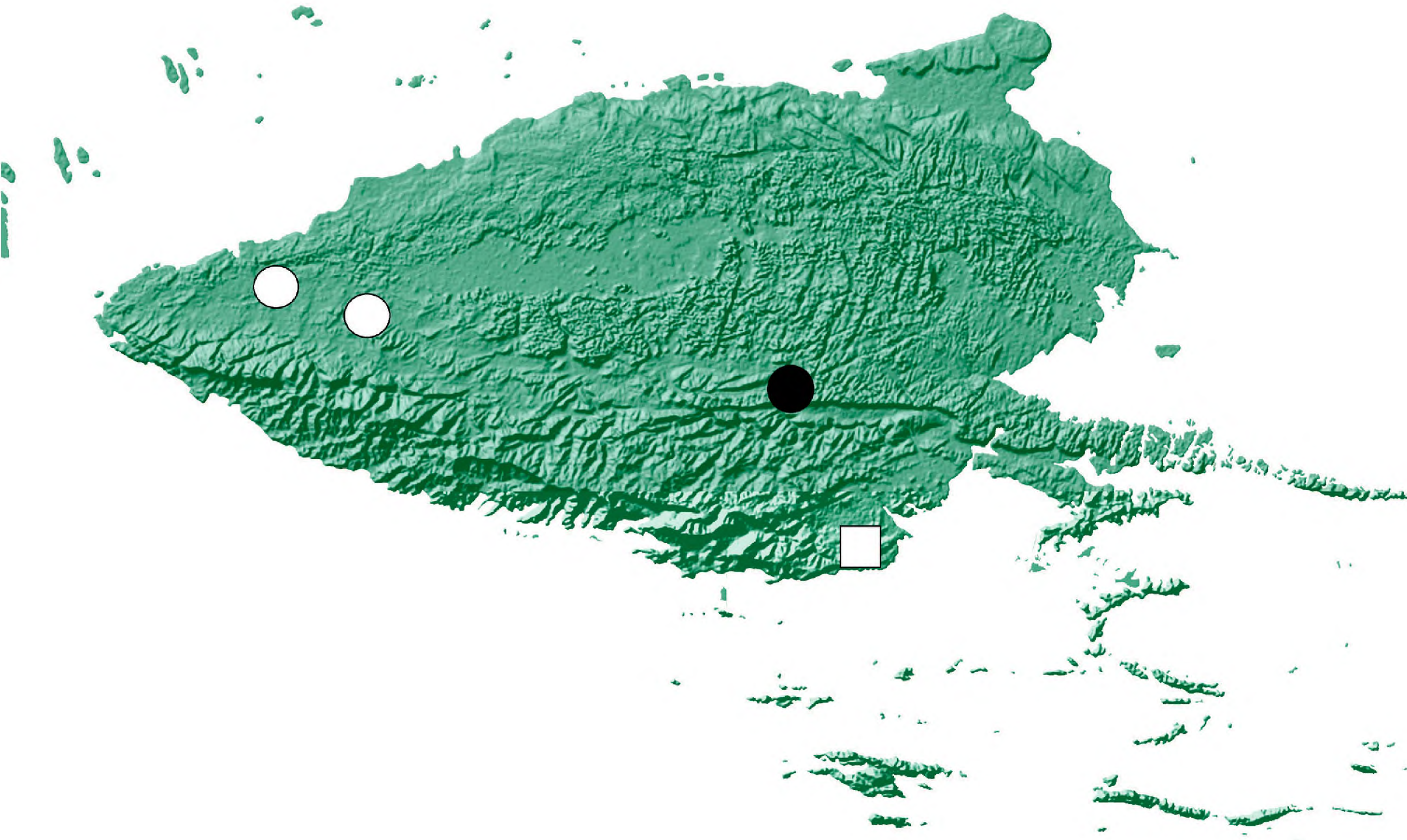


Map 14. Distribution of Diplommatinidae on Lesser Sunda Islands. Circles – *Diplommatina* (s. l.) *leucopsis* van Benthem Jutting, 1958; filled circle – *D.* (s. l.) *lucifuga* van Benthem Jutting, 1958; squares – *Palaina* (s. l.) *chrysostoma* E.A. Smith, 1897 & *P.* (s. l.) *polystoma* B. Rensch, 1931; filled square – *P.* (s. l.) *mutis* sp. nov.

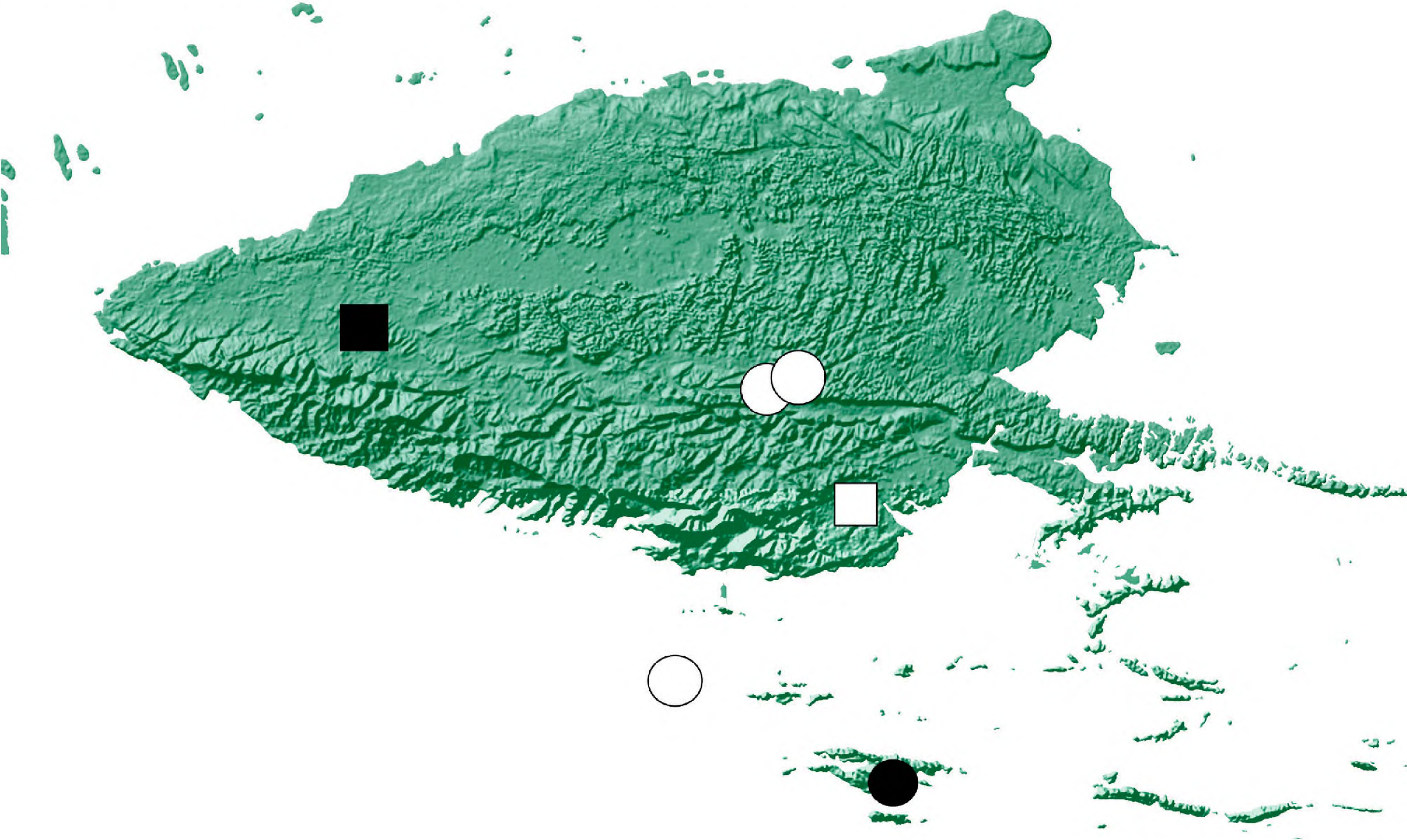


Map 15. Distribution of Diplommatinidae on Aru and Tanimbar islands. Circle – *Arinia* (s. l.) *tjendanae* B. Rensch, 1931 (see also map 12); filled circle – *Diplommatina* (s. l.) *mertonii* C.R. Boettger, 1922; square – *Palaina* (s. l.) *mirifica* sp. nov., *P.* (s. l.) *tanimbarensis* sp. nov., *P.* (s. l.) *thomasrinteleni* sp. nov. & *P.* (s. l.) *yamdene* sp. nov.; filled square – *P.* (s. l.) *vermeuleni* sp. nov.





Map 16. Distribution of Diplommatinidae on Misool Island. Circles – *Moussonia hyponepia* (van Benthem Jutting, 1958), *M. omias* (van Benthem Jutting, 1958), *Palaina* (s. l.) *erythropeplos* van Benthem Jutting, 1958, *P.* (s. l.) *leptotoreutos* van Benthem Jutting, 1958 & *P.* (s. l.) *scaveola* van Benthem Jutting, 1958; filled circle – *M. monstificabilis* sp. nov. & *P.* (s. l.) *psittricha* sp. nov.; filled circle & square – *P.* (s. l.) *minuscularia* sp. nov.



Map 17. Distribution of Diplommatinidae on Misool Island. Circles – *Moussonia separanda* sp. nov.; filled circle – *Palaina* (s. l.) *insulana* sp. nov.; square – *P.* (s. l.) *misoolensis* sp. nov.; filled square – *P.* (s. l.) *quadricornis* van Benthem Jutting, 1958.





Map 18. Distribution of Diplommatinidae on Misool Island. Circle – *Diplommatina* (s. l.) *telnovi* sp. nov. (see also map 22) & *Palaina* (s. l.) *attenboroughi* sp. nov.; circle & filled circles – *P.* (s. l.) *bicornis* van Benthem Jutting, 1958.



Map 19. Distribution of Diplommatinidae on Bougainville islands. Circle – *Palaina* (s. l.) *aerari* (Dell, 1955) (see also map 11), *P.* (s. l.) *gardneri* Dell, 1955 & *P.* (s. l.) *solomonensis* (Dell, 1955); filled circles – *P.* (s. l.) *bougainvillei* sp. nov.



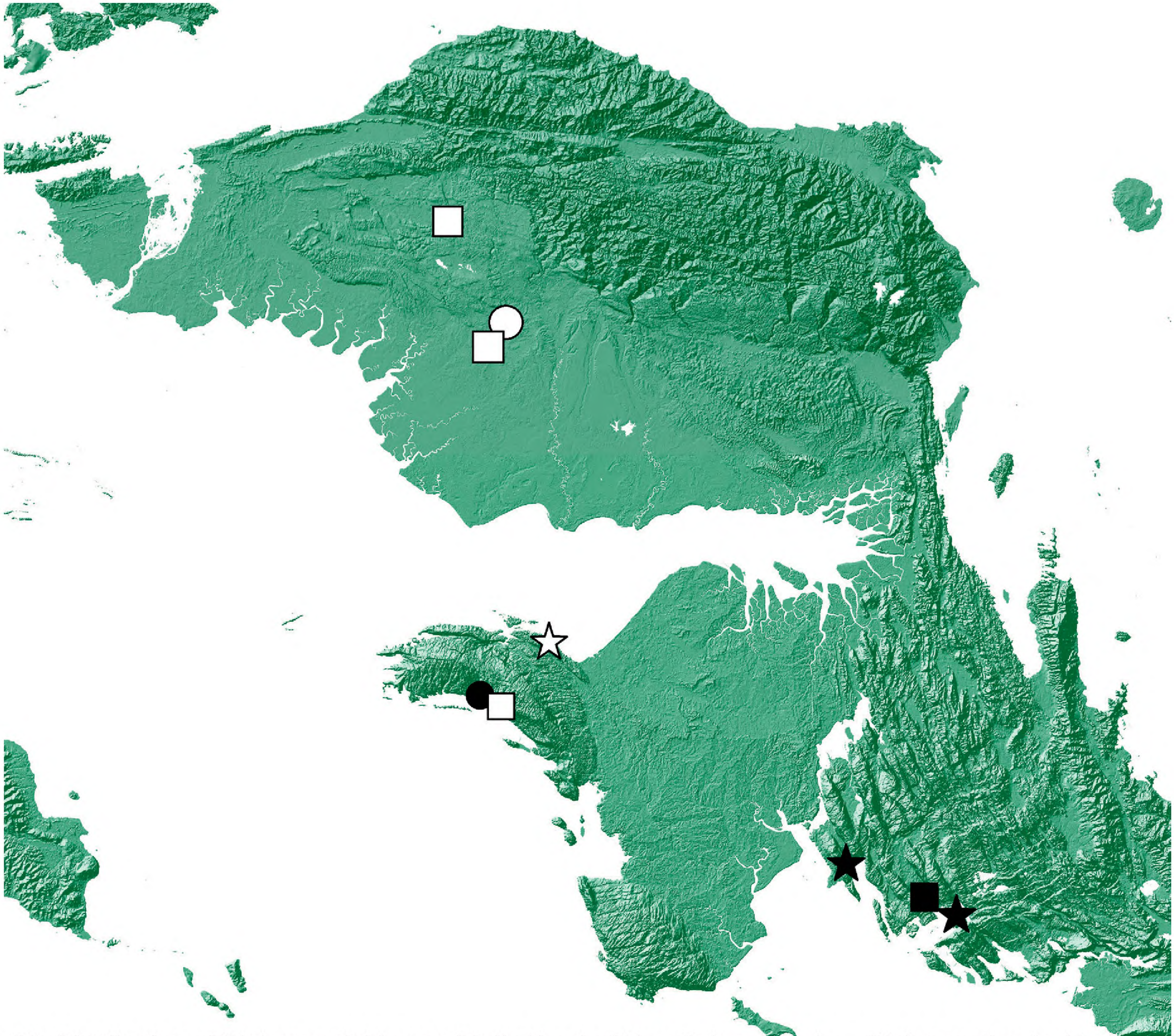


Map 20. Distribution of Diplommatinidae on Waigeo and Wayag islands. Circles – *Diplommatina* (s. l.) *waigeoensis* sp. nov.; filled circle – *Palaina* (s. l.) *laszloi* sp. nov.; square – *P.* (s. l.) *imperfecta* sp. nov., *P.* (s. l.) *ponsonbyi* Sykes, 1903, *P.* (s. l.) *silvicultrix* sp. nov., and *P.* (s. l.) *wawiyai* sp. nov.

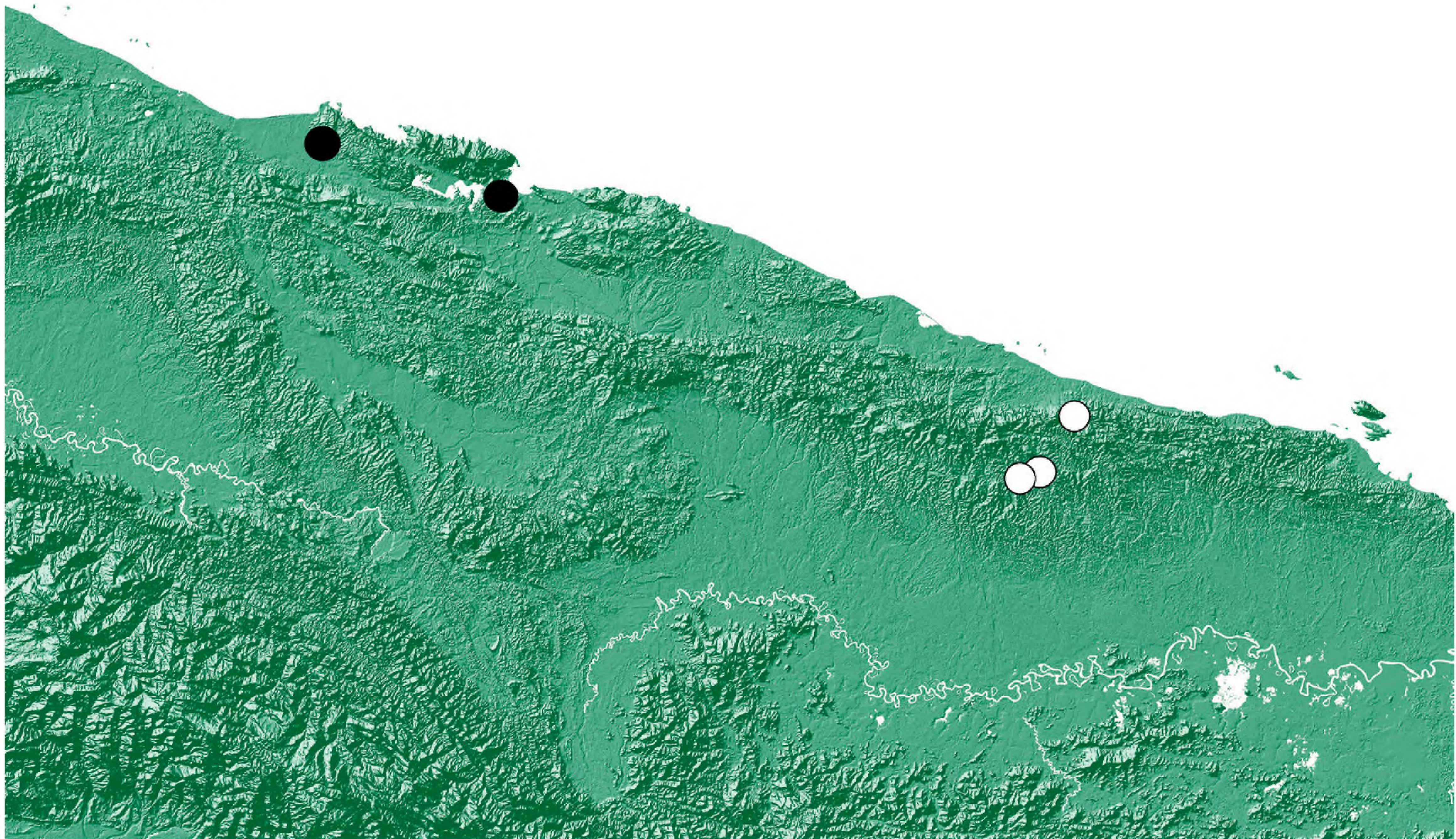


Map 21. Distribution of Diplommatinidae on Waigeo and Wayag islands. Circles – *Palaina* (s. l.) *hartmanni* sp. nov. & *P.* (s. l.) *telnovi* sp. nov.; filled circle – *P.* (s. l.) *megalostoma* sp. nov.; filled circle & square – *P.* (s. l.) *paradisaea* sp. nov.; filled square – *P.* (s. l.) *sparselamellata* sp. nov.; circles & star – *P.* (s. l.) *waigeo* sp. nov.



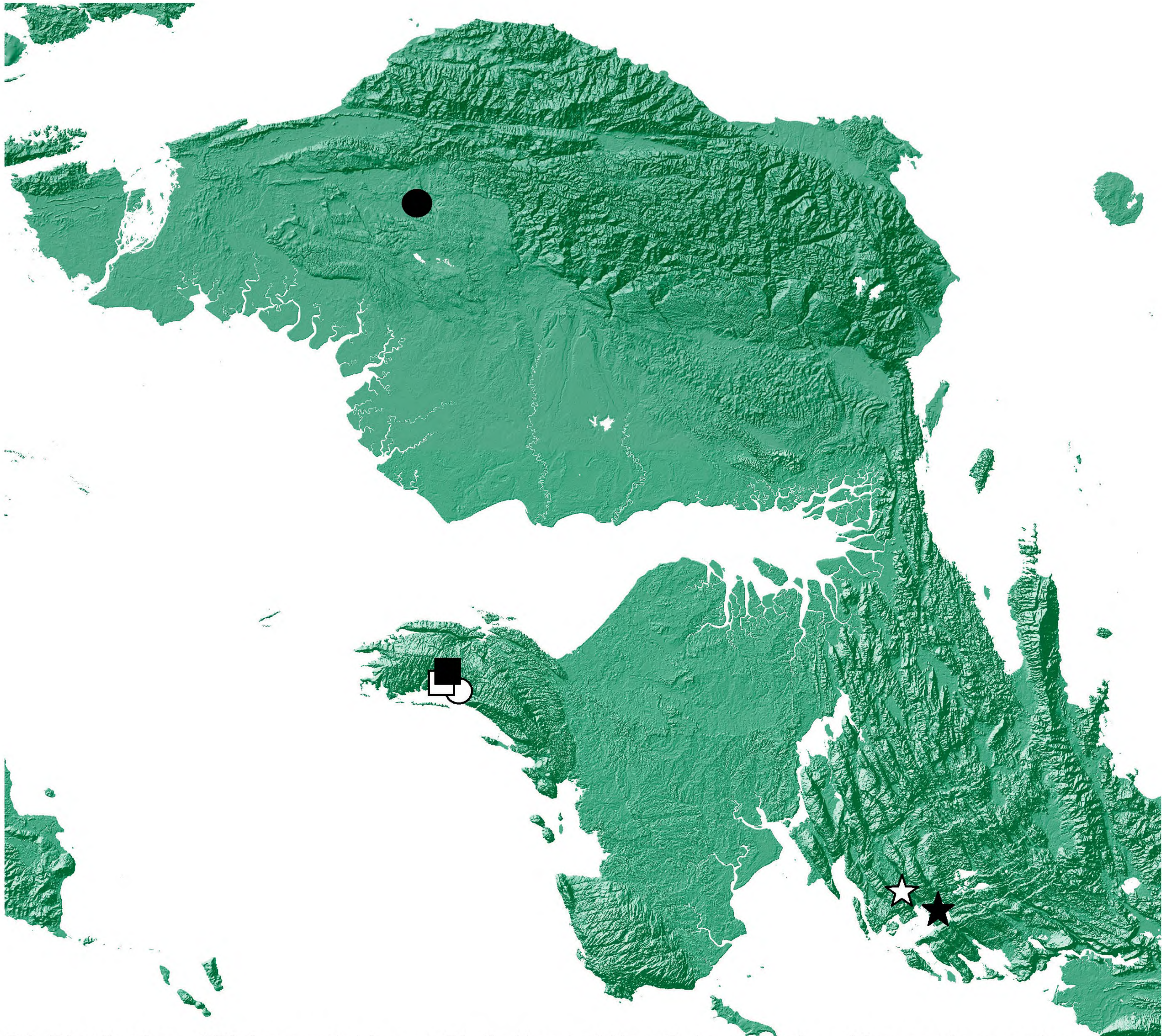


Map 22. Distribution of Diplommatinidae on Bird's Head of New Guinea. Circle – *Diplommatina* (s. l.) *malbrat* sp. nov.; filled circle – *D.* (s. l.) *smithi* Kobelt, von Möllendorff, 1898; circle & squares – *D.* (s. l.) *telnovi* sp. nov. (see also map 18); filled square – *Moussonia echinata* sp. nov.; star – *Palaina* (s. l.) *dianctoides* sp. nov.; filled stars – *P.* (s. l.) *flavocylindrica* sp. nov.

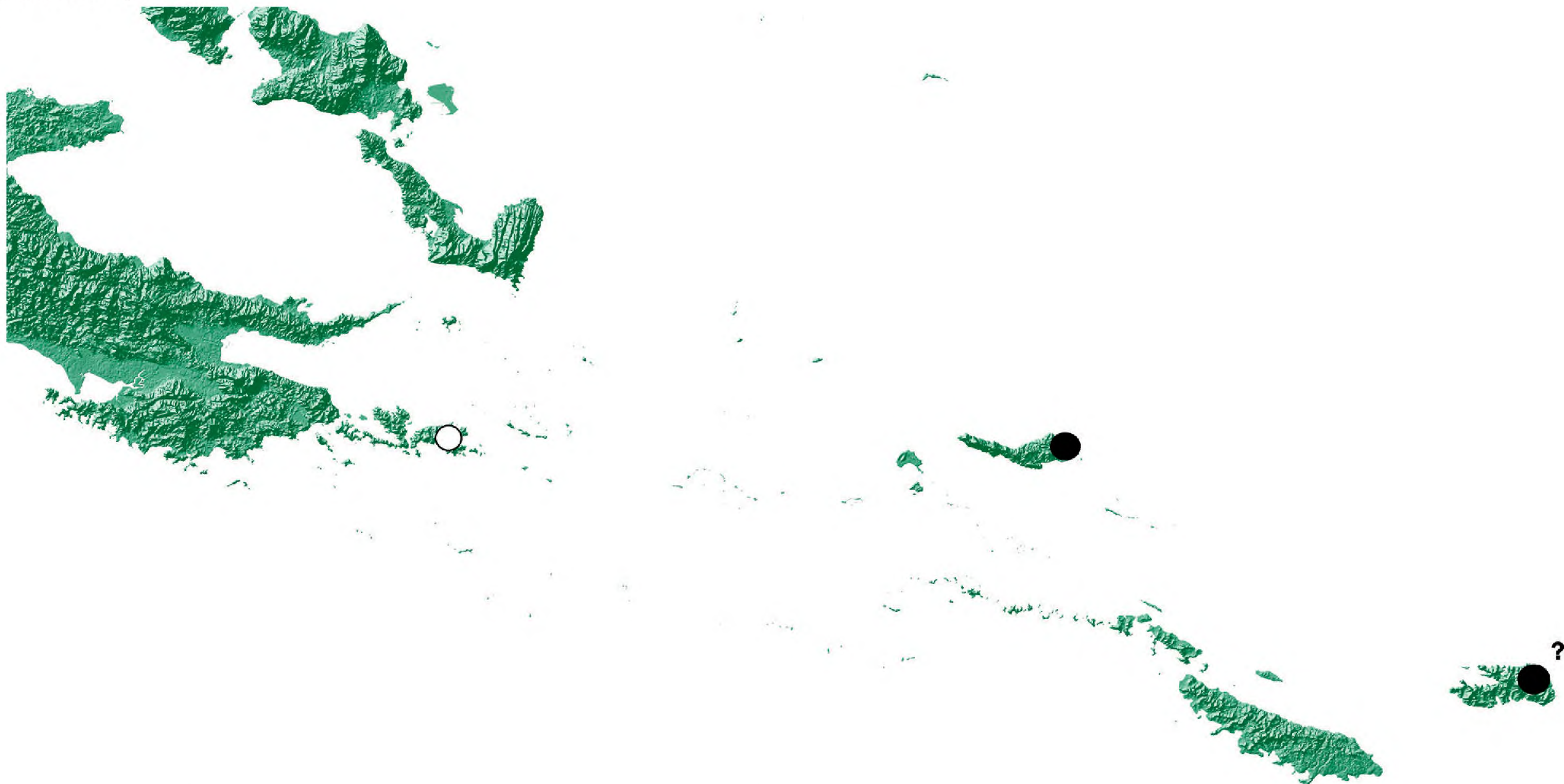


Map 23. Distribution of Diplommatinidae on North New Guinea. Circles – *Moussonia torricelli* sp. nov.; filled circles – *Palaina* (s. l.) *consobrina* van Benthem Jutting, 1963.





Map 24. Distribution of Diplommatinidae on Bird's Head of New Guinea. Circle – *Moussonia pseudoseparanda* sp. nov.; filled circle – *Palaina* (s. l.) *doberai* sp. nov. & *P.* (s. l.) *perspectiva* sp. nov.; circle & square – *P.* (s. l.) *dohertyi* E.A. Smith, 1897; filled square – *P.* (s. l.) *iha* sp. nov.; star – *P.* (s. l.) *lengguru* sp. nov.; star & filled star – *P.* (s. l.) *mairasi* sp. nov.



Map 25. Distribution of Diplommatinidae on Louisiade Islands. Circle – *Diplommatina* (s. l.) *symmetrica* Hedley, 1891; filled circles – *Palaina* (s. l.) *louisade* sp. nov. (see comments in the text).





Map 26. Distribution of Diplommatinidae on New Guinea. Circles – *Palaina* (s. l.) *adelpha* Soós, 1911; filled circle – *P.* (s. l.) *bundiana* Wiktor, 1998; square – *P.* (s. l.) *citrinella* van Benthem Jutting, 1963; filled square – *P.* (s. l.) *cupulifera* van Benthem Jutting, 1963; stars – *P.* (s. l.) *extremita* sp. nov.; filled star – *P.* (s. l.) *glabella* van Benthem Jutting, 1963 & *P.* (s. l.) *repandostoma* van Benthem Jutting, 1963; four-point stars – *P.* (s. l.) *novoguineensis* E.A. Smith, 1897; filled four-point stars – *P.* (s. str.) *papuanorum* Soós, 1911; triangles – *P.* (s. l.) *slapcinskyi* sp. nov.

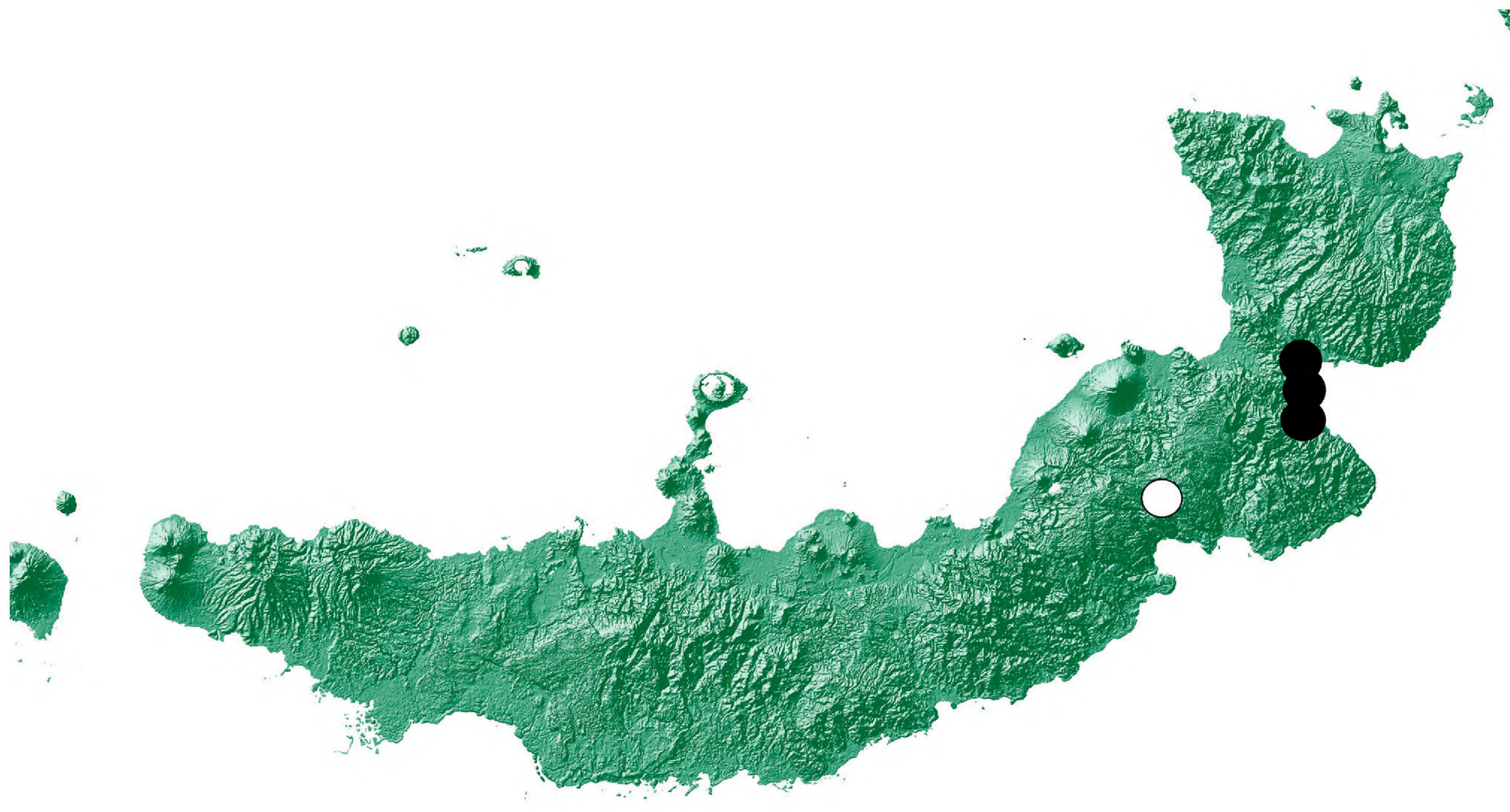


Map 27. Distribution of Diplommatinidae on New Guinea. Circles – *Palaina* (s. l.) *biroi* Soós, 1911; filled circle – *P.* (s. l.) *inconspicua* van Benthem Jutting, 1963; square – *P.* (s. l.) *liliputana* van Benthem Jutting, 1963; filled square – *P.* (s. l.) *onin* sp. nov.; star – *P.* (s. l.) *albrechti* sp. nov.; filled star – *P.* (s. l.) *papuanontis* sp. nov.; four-point stars – *P.* (s. l.) *propinqua* van Benthem Jutting, 1963.





Map 28. Distribution of Diplommatinidae on New Britain Island. Circles & filled circles – *Palaina* (s. l.) *commixta* I. Rensch, 1937; filled circles – *P.* (s. l.) *granulum* I. et B. Rensch, 1929 & *P.* (s. l.) *schneideri* I. et B. Rensch, 1929.

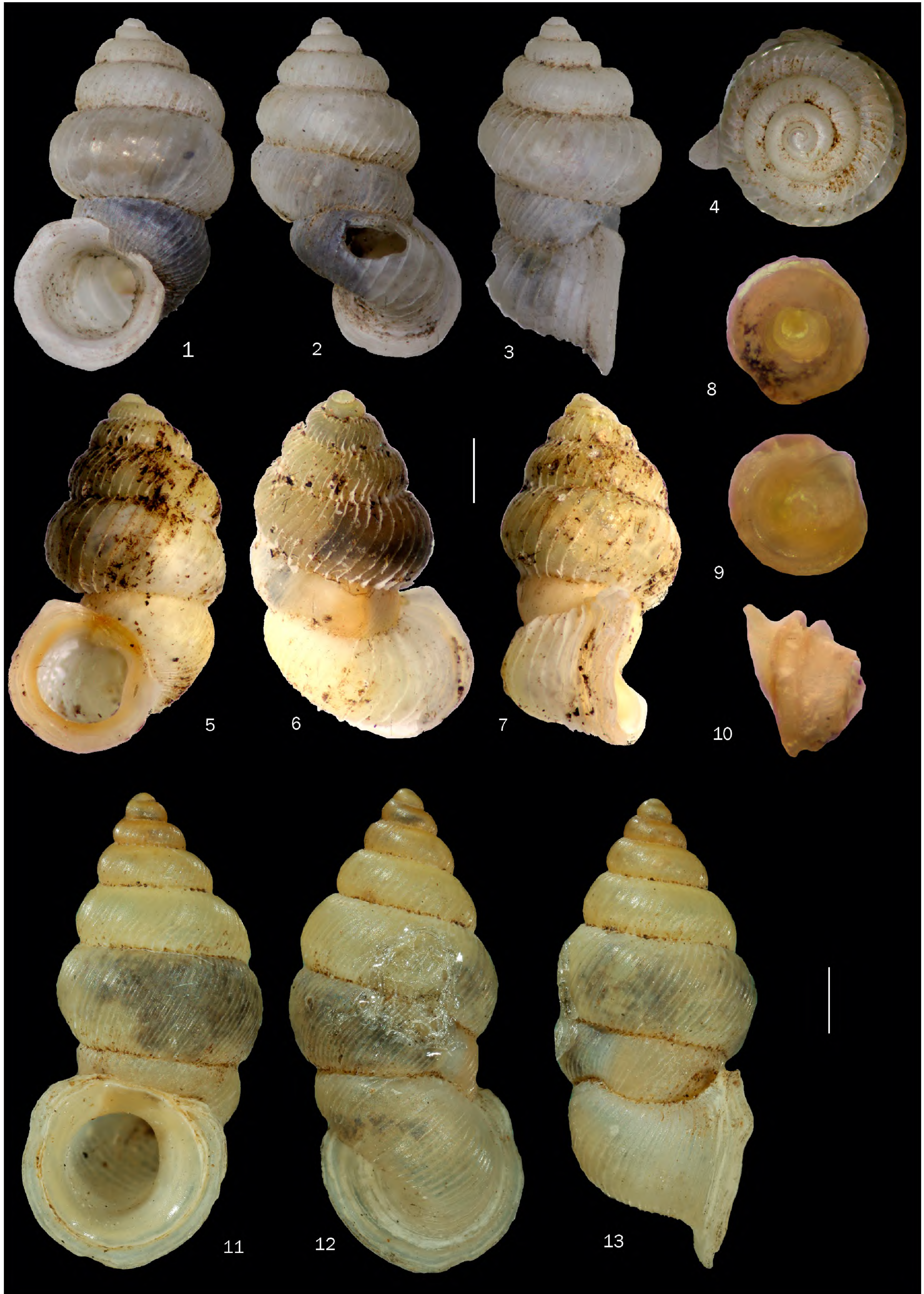


Map 29. Distribution of Diplommatinidae on New Britain Island. Circle – *Palaina* (s. l.) *mengen* sp. nov.; filled circles – *P.* (s. l.) *novopommerana* I. et B. Rensch, 1929.



Plate 19

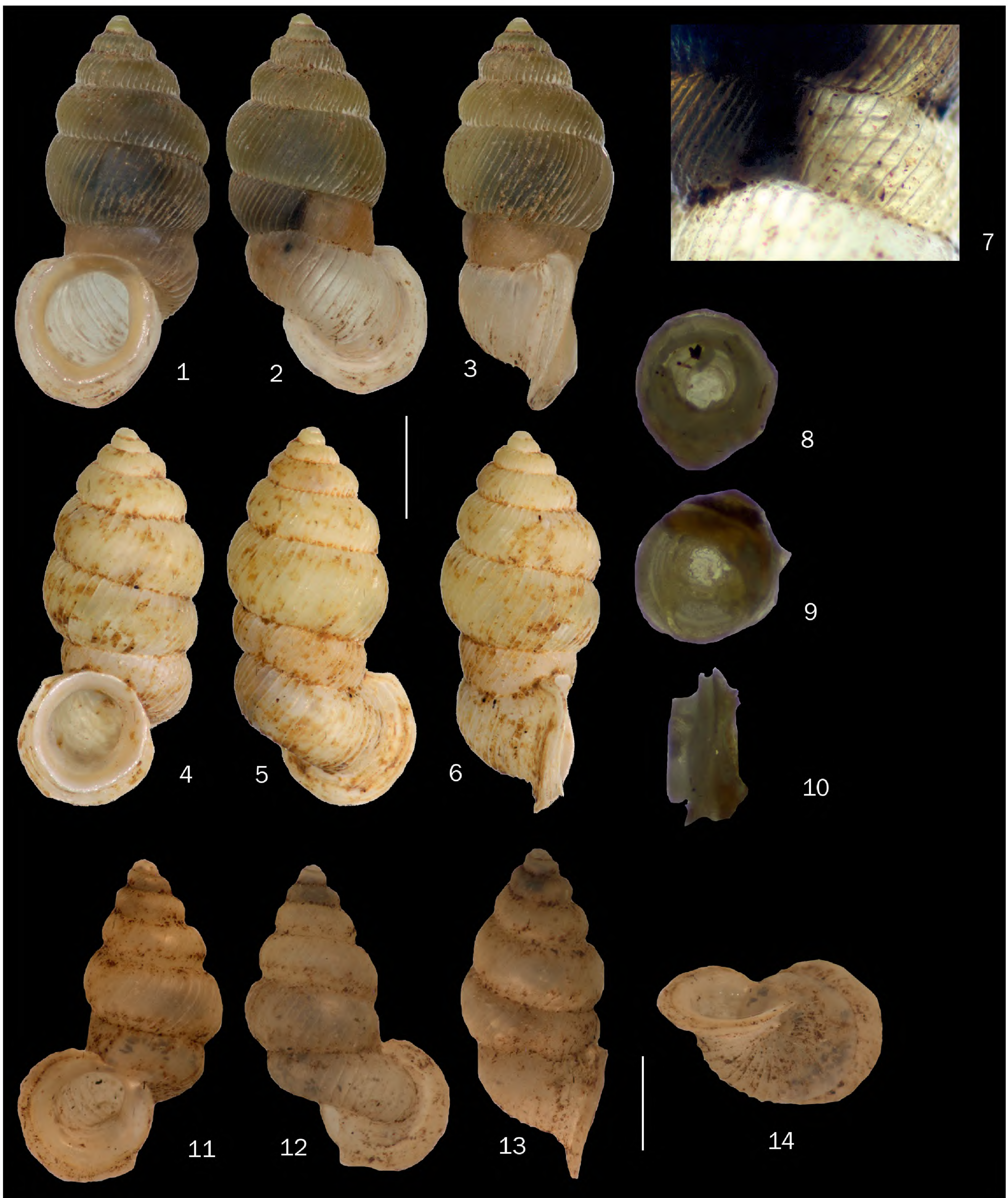
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-13. Papuan Diplommatinidae. *Diancta* s. str. Martens, 1864. 1-10 – *Diancta* (s. str.) *constricta* (Martens, 1864): 1-4 – Lectotype in apertural, abapertural, lateral, and top view; 5-10 – Specimen from Tidore Island (8-10 – Operculum, outer surface (8), inner surface (9) and lateral view (10)); 11-13 – *D. (s. str.) multiplicata* von Möllendorff, 1902, holotype; photos: SMF [scale bars 1 mm].

Plate 20

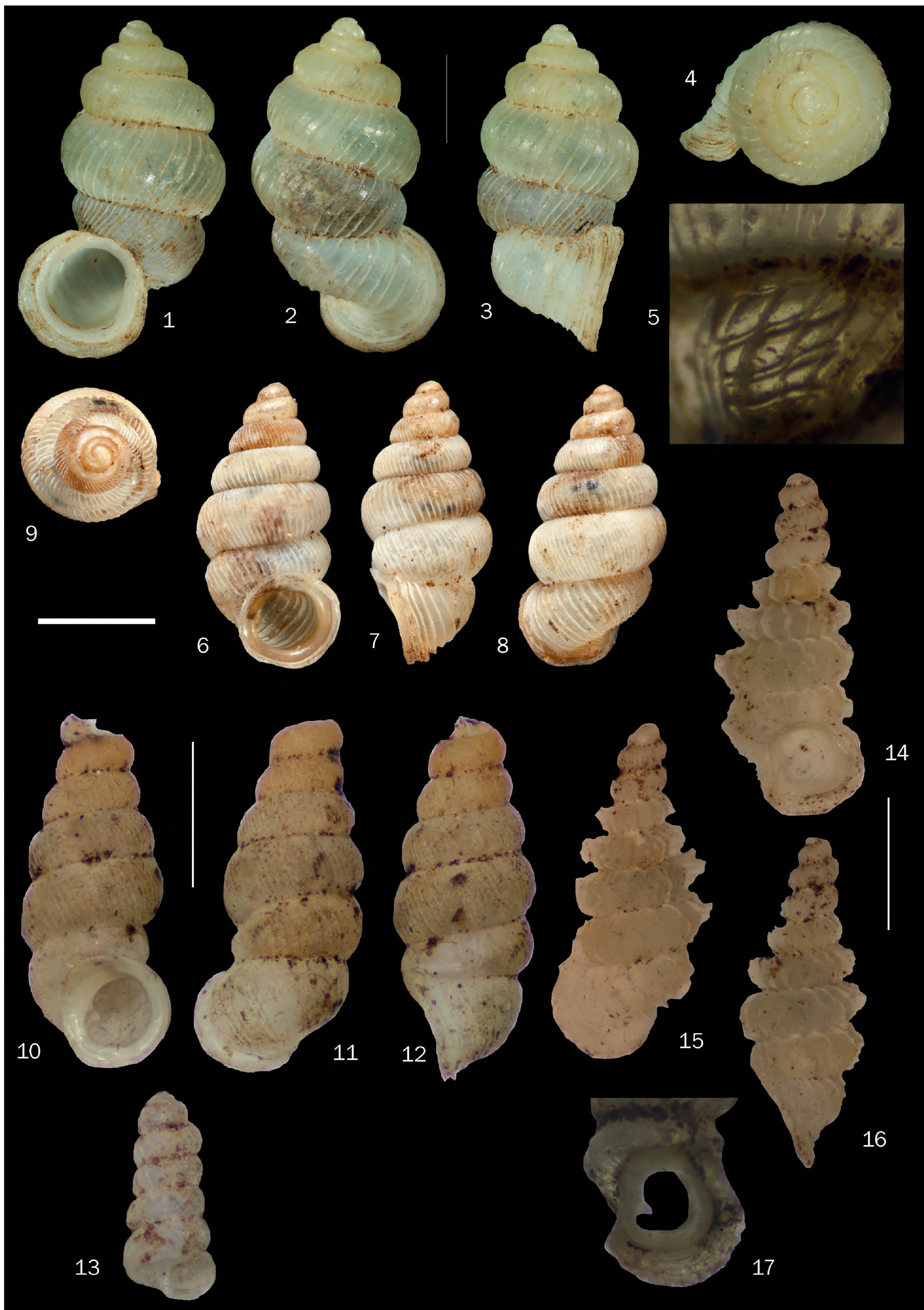
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-14. Papuan Diplommatinidae. *Diancta* s. str. Martens, 1864. 1-10 – *Diancta* (s. str.) *halmaherica* sp. nov.: 1-3 – Holotype in apertural, abapertural, and lateral view; 4-10 – Paratype from 10 km SW Tilope vill.: 7 – Four palatalis as seen through the shell wall); 8-10 – Operculum, outer surface (8), inner surface (9) and lateral view (10); 11-14 – *D.* (s. str.) *obiensis* sp. nov., holotype [scale bars 1 mm].

Plate 21

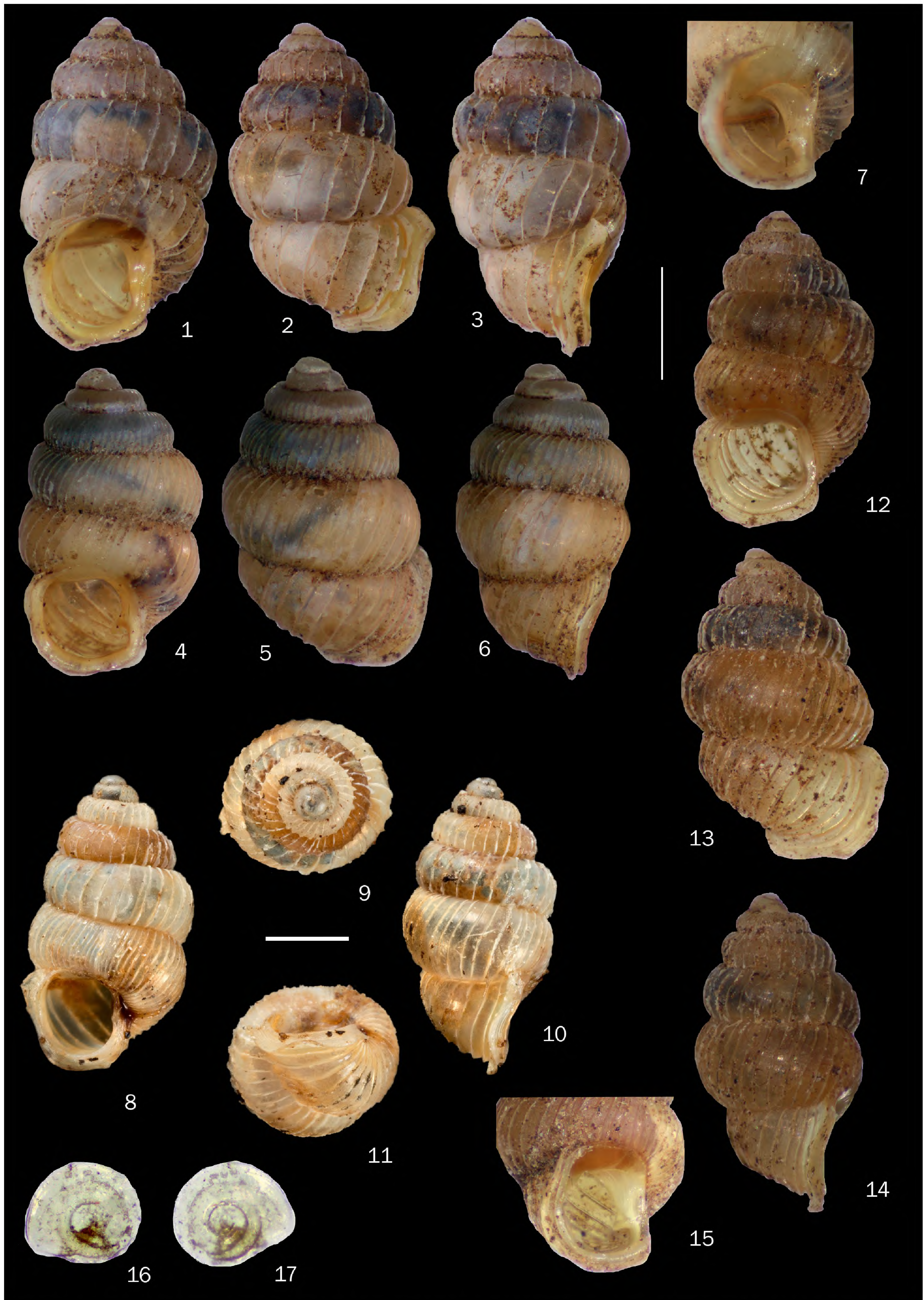
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-17. Papuan Diplommatinidae. *Diancta* s. str. Martens, 1864 & *Diplommatina* s. l. Benson, 1849. 1-5 – *Diancta* (s. str.) *torta* O. Boettger, 1891, holotype in apertural, abapertural, lateral and top view and four palatalis as seen through the shell wall; photos 1-4: SMF; 6-9 – Syntype *Diplommatina* (s. l.) *baliana* (Fulton, 1899), photos: BMNH; 10-13 – *D.* (s. l.) *decollata* van Benthem Jutting, 1958, holotype and juvenile paratype in apertural view (13); 14-17 – *D.* (s. l.) *slapcinskyi* sp. nov., holotype (14-16) and paratype's aperture (17) [scale bars 1 mm].

Plate 22

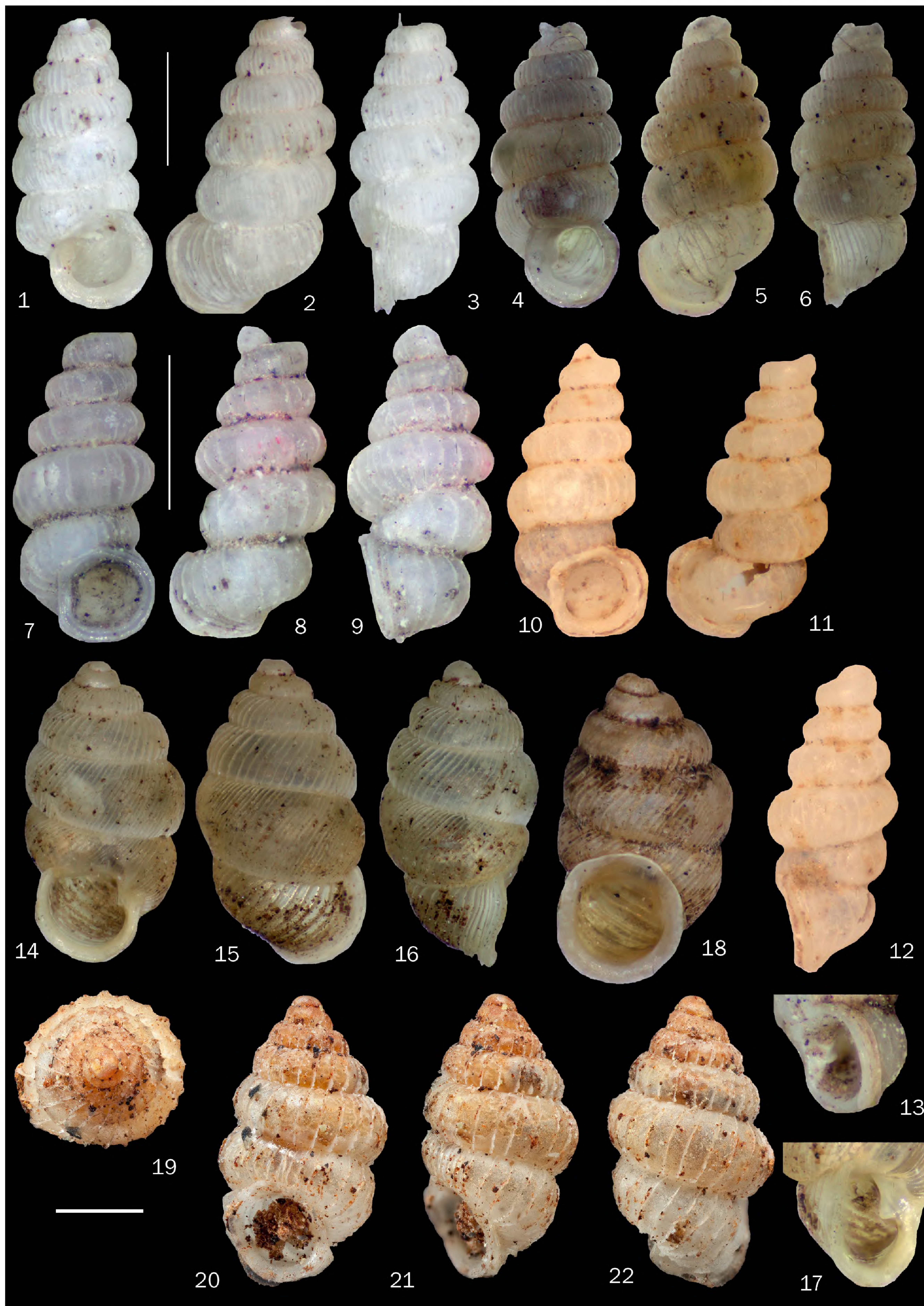
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-17. Papuan Diplommatinidae. *Diplommatina* s. l. Benson, 1849. 1-7 – *Diplommatina* (s. l.) *floresiana* E.A. Smith, 1897, specimen from Ranamese env. (Flores Island; 1-3) in apertural, abapertural, and lateral view and specimens from Mount Ranaka (Flores Island; 4-7); 8-17 – *D. (s. l.) jonabletti* sp. nov.: 8-11 – Syntype *D. floresiana*, photos: BMNH; 12-17 – Specimen from Mount Ranaka (Flores Island) (9 – Top view; 11 – Basal view); 16-17 – Operculum, outer (16) and inner surface (17) [scale bars 1 mm].

Plate 23

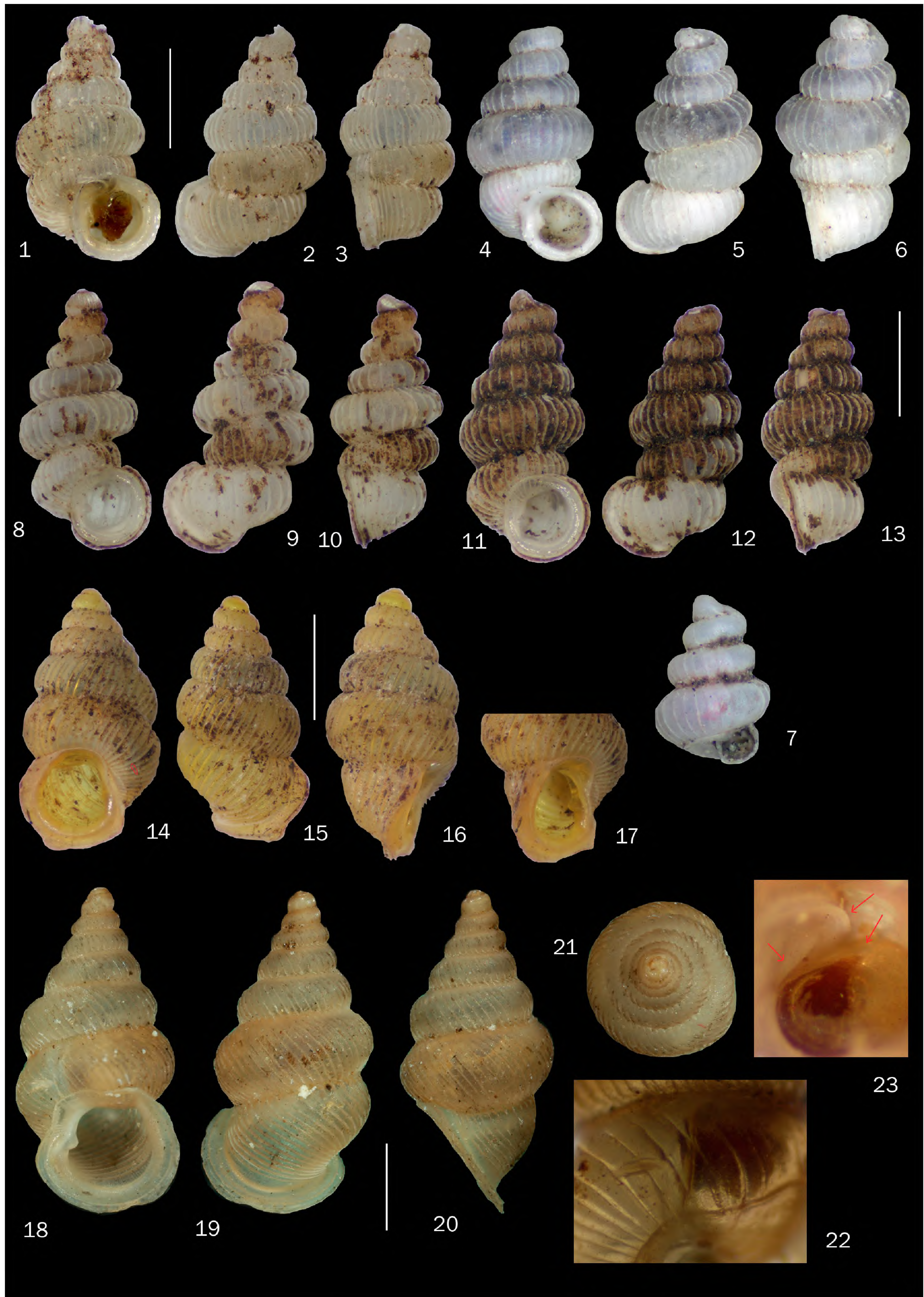
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Figures 1-22. Papuan Diplommatinidae. *Diplommatina* s. l. Benson, 1849. 1-6 – *Diplommatina* (s. l.) *floris* B. Rensch, 1931, holotype (1-3) and paratype (4-6) in apertural, abapertural, lateral, and top view; 7-13 – *D.* (s. l.) *fluminis* B. Rensch, 1931, paratype (7-9) and specimens from Noilmina env. (Timor Island; 10-13); 14-18 – *D.* (s. l.) *javana* von Möllendorff, 1897, holotype *D. javana orientalis* B. Rensch, 1931 (14-17) and paratype (18) *D. javana orientalis*; 19-22 – *D.* (s. l.) *lombockensis* E.A. Smith, 1898, syntype; photos: BMNH [scale bars 1 mm].

Plate 24

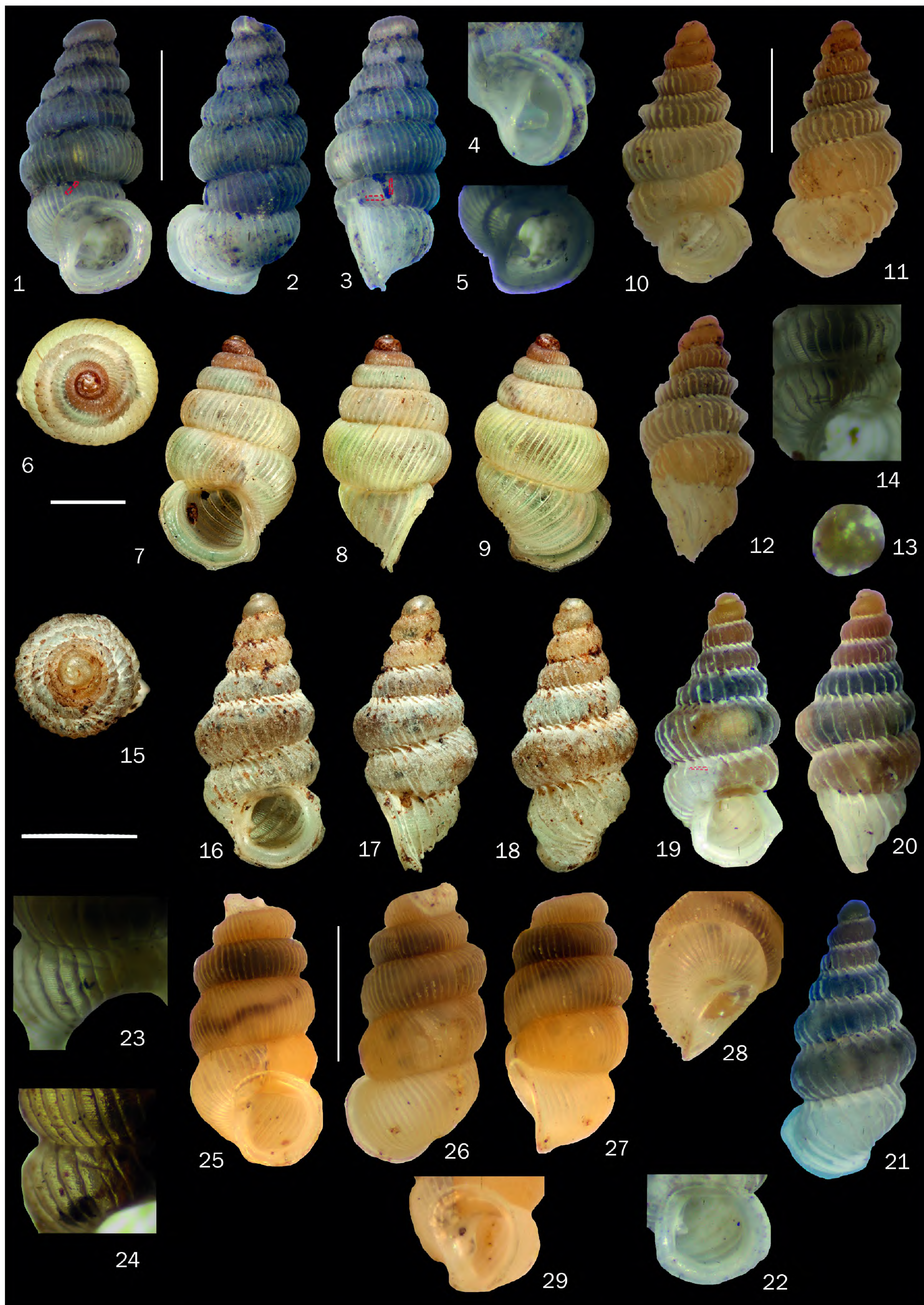
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Figures 1-23. Papuan Diplommatinidae. *Diplommatina* s. l. Benson, 1849. 1-7 – *Diplommatina* (s. l.) *leucopsis* van Benthem Jutting, 1958, holotype (1-3), adult paratype (4-6) and juvenile paratype (7) in apertural, abapertural, and lateral view; 8-13 – *D. (s. l.) lucifuga* van Benthem Jutting, 1958, holotype (8-10) and paratype (11-13); 14-17 – *D. (s. l.) maibrat* sp. nov., holotype; 18-23 – *D. (s. l.) mertonii* C.R. Boettger, 1922, holotype (18-21; photos: SMF) and internal lamellae apparatuses of paratypes (22-23; consider red arrows pointing on parietalis and palatalis) [scale bars 1 mm].

Plate 25

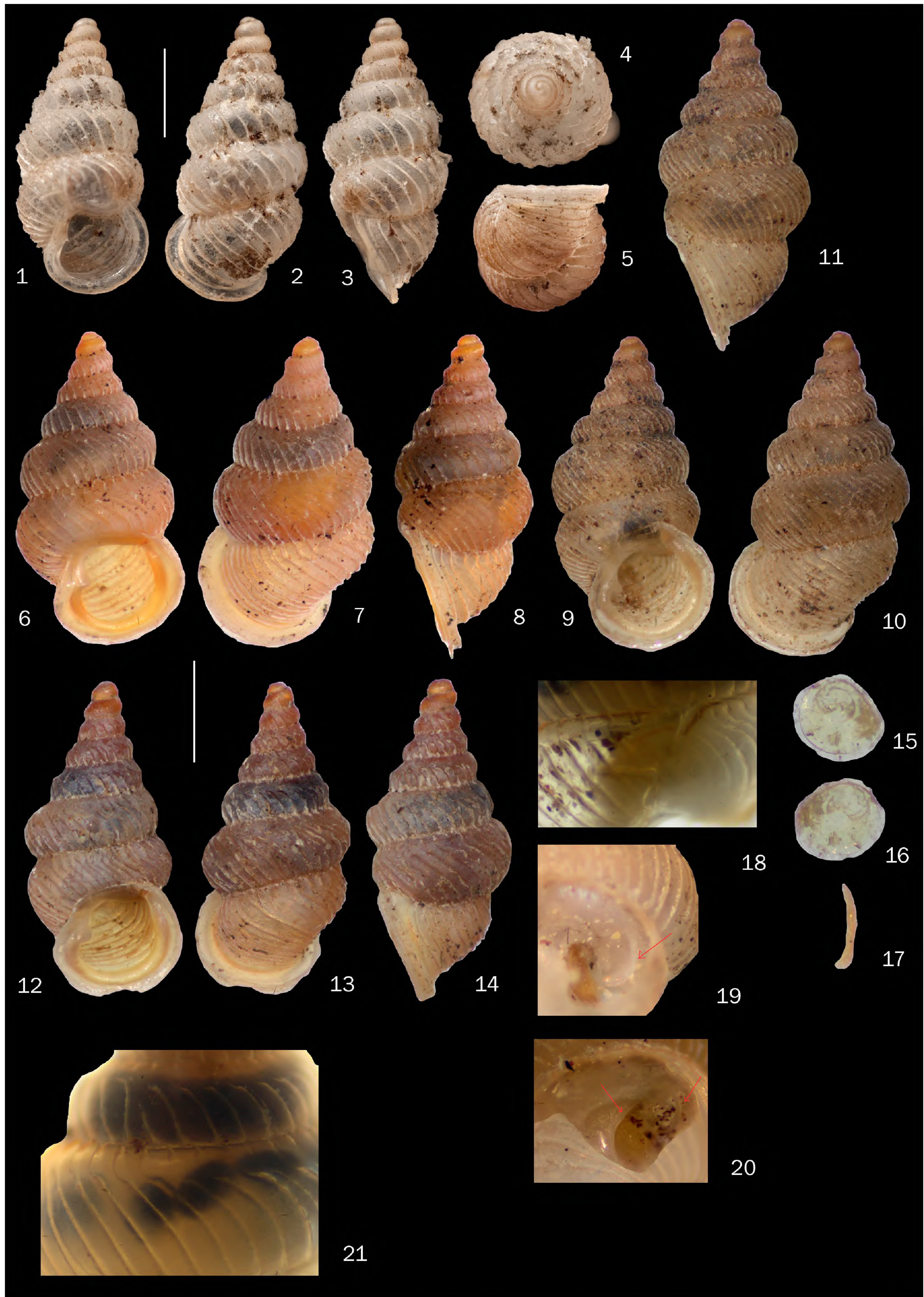
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Figures 1-29. Papuan Diplommatinidae. *Diplommantina* s. l. Benson, 1849. 1-5 – *Diplommantina* (s. l.) *moluccensis* sp. nov., holotype (1-3) in apertural, abapertural, and lateral view (consider red dashes pointing on positions of internal lamellae) and aperture of a paratype (4-5); 6-9 – *D.* (s. l.) *smithi* Kobelt, von Möllendorff, 1898, syntype *D. papuana* E.A. Smith, 1897; photos: BMNH; 10-14 – *D.* (s. l.) *patani* sp. nov., paratype with internal lamellae apparatus as seen through the shell wall (13) and outer surface of operculum (14); 15-24 – *D.* (s. l.) *radiiformis* Preston, 1913, syntype (15-18; photos: BMNH) and specimens from Galela, NE Halmahera (19-24); 25-29 – *D.* (s. l.) *timorensis* sp. nov., holotype (28 – Basal view) [scale bars 1 mm].

Plate 26

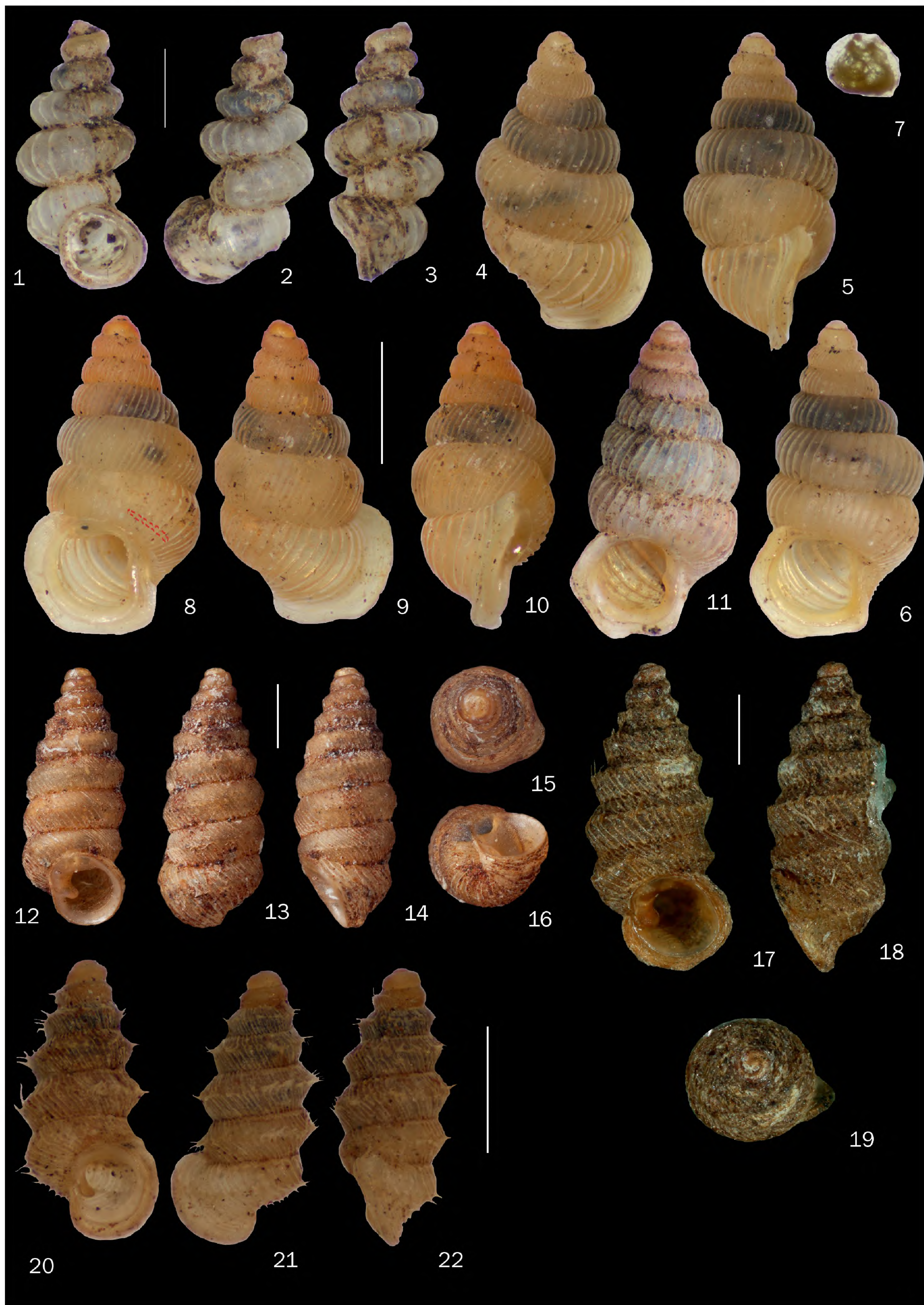
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Figures 1-21. Papuan Diplommatinidae. *Diplommattina* s. l. Benson, 1849. 1-5 – *Diplommattina* (s. l.) *symmetrica* Hedley, 1891, lectotype (1-4) and paralectotype (5) in apertural, abapertural, lateral, top, and basal view; photos: BMNH; 6-21 – *D. (s. l.) telnovi* sp. nov.: 6-8 – Specimen from Uter lakeside, Doberai Peninsula (New Guinea); 9-11 & 18-19 – Specimen from Misool Island; 12-14 – Specimen from River Sakarteman valley, Onin Peninsula (New Guinea); 15-17 – Operculum, outer (15), inner surface (16), and lateral view (17); 18-20 – Internal lamellae apparatus of a paratype as seen through the shell wall (18), consider red arrows pointing on parietalis and palatalis (19-20); 21 – Structure of teleoconch axial ribs [scale bars 1 mm].

Plate 27

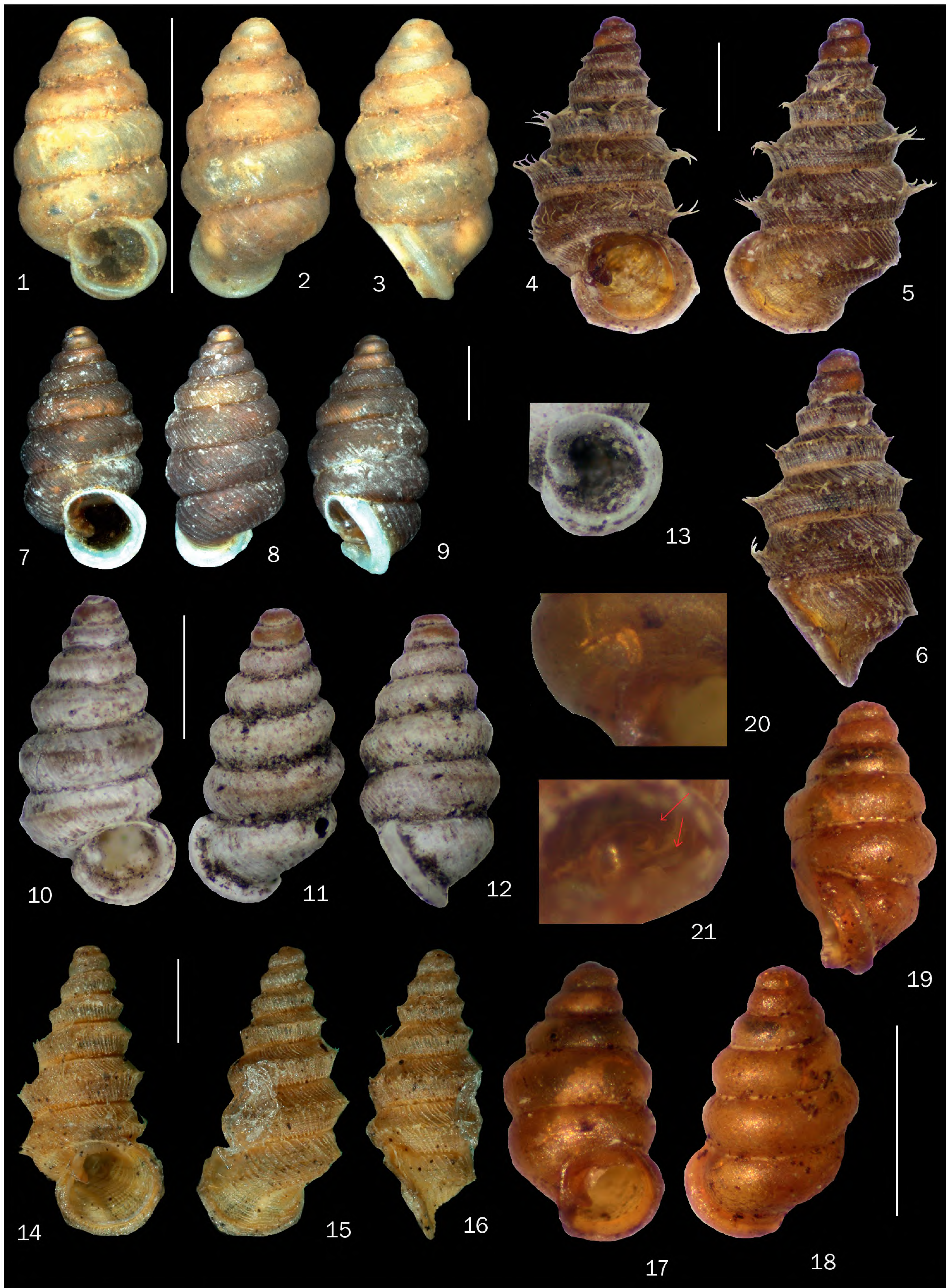
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Figures 1-22. Papuan Diplommatinidae. *Diplommatina* s. l. Benson, 1849 & *Moussonia* O. Semper, 1865. 1-3 – *Diplommatina* (s. l.) *torquilla* van Benthem Jutting, 1958, holotype in apertural, abapertural, and lateral view; 4-11 – *D.* (s. l.) *waigeoensis* sp. nov., paratypes (consider red dashes pointing on position of internal lamella on Fig. 8); 7 – Operculum, outer surface; 12-16 – *Moussonia athena* (Preston, 1913). lectotype (15 – Top view; 16 – Basal view); photos: BMNH; 17-19 – *M. hirsuta* (Zilch, 1953), holotype; photos: SMF; 20-22 – *M.* (s. l.) *echinata* sp. nov., holotype [scale bars 1 mm].

Plate 28

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Figures 1-21. Papuan Diplommatinidae. *Moussonina* O. Semper, 1865. 1-3 – *Moussonina hyponepia* (van Benthem Jutting, 1958), holotype in apertural, abapertural, and lateral view; photos: NMNL; 4-6 – *M. manuselae* sp. nov., holotype; 7-9 – *M. omias* (van Benthem Jutting, 1958), paratype; photos: NMNL; 10-13 – *M. papuana* (Tapparone Canefri, 1883), paralectotypes; 14-16 – *M. strubelli* (O. Boettger, 1891), holotype; photos: SMF; 17-21 – *M. torricelli* sp. nov., holotype: 20 – Internal lamellae apparatus as seen through the shell wall; 21 – Paratype, position of two parietalis (consider red arrows) [scale bars 1 mm].

Plate 29

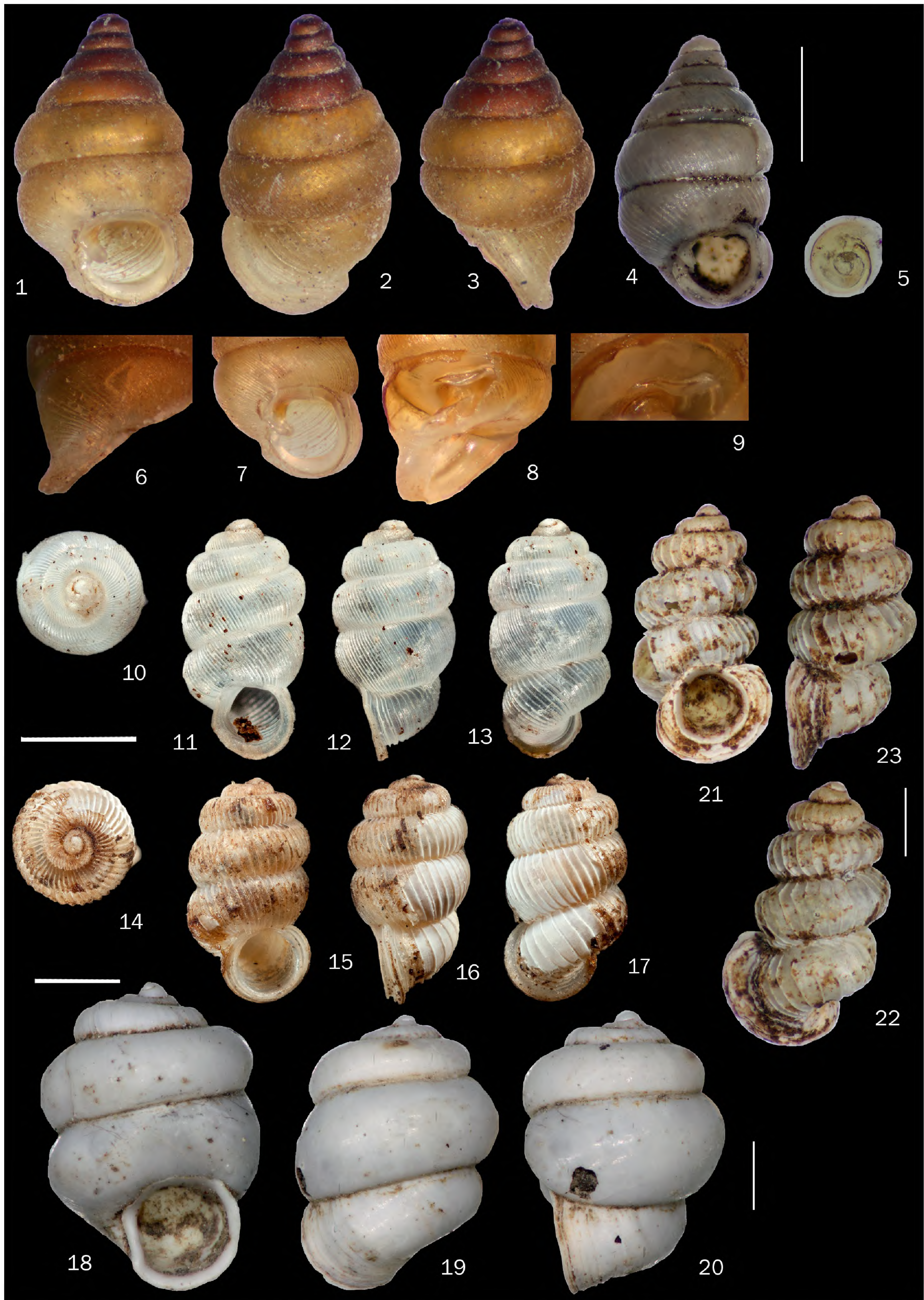
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Figures 1-17. Papuan Diplommatinidae. *Moussonia* O. Semper, 1865 & *Arinia* s. l. H. et A. Adams, 1856. 1-8 – *Moussonia monstificabilis* sp. nov., paratypes in apertural, abapertural, and lateral view (1-4), aperture (8) and subadult specimens (5-7); 9-12 – *M. pseudoseparanda* sp. nov., holotype; 13-17 – *Arinia* (s. l.) *tjendanae* B. Rensch, 1931, paratype (13-16) and holotype (17) [scale bars 1 mm].

Plate 30

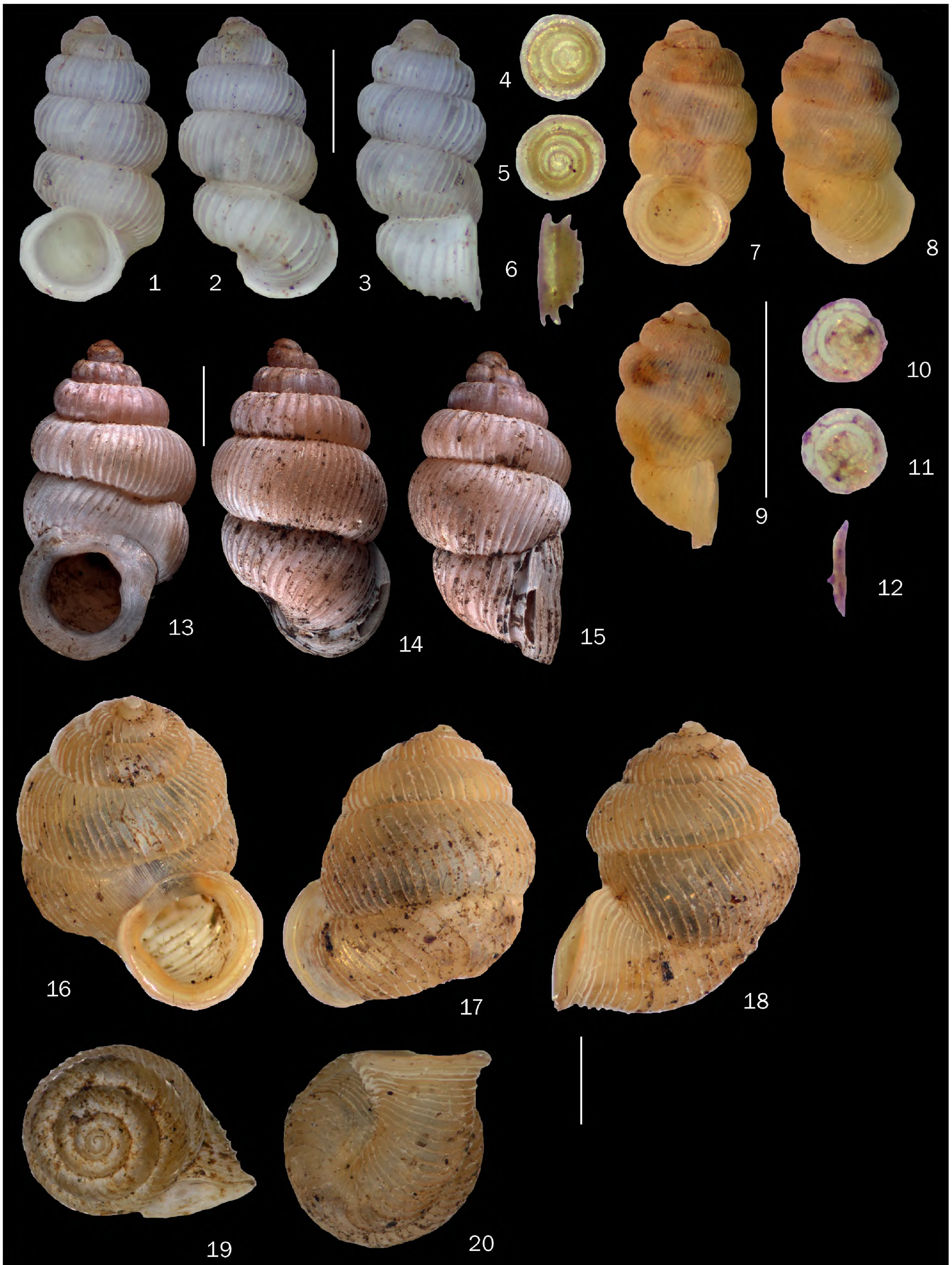
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-23. Papuan Diplommatinidae. *Moussonia* O. Semper, 1865 & *Arinia* s. l. H. et A. Adams, 1856. 1-9 – *Moussonia separanda* sp. nov., paratypes in apertural, abapertural, and lateral view: 1-3 & 5-9 – Specimen from locus typicus: 5 – Operculum, outer surface; 6-7 – Internal lamellae apparatus as seen through the shell wall; 8-9 – Internal lamellae apparatus; 4 – Specimen from Yan Island S of Misool; 10-13 – *Arinia* (s. l.) *blanda* E.A. Smith, 1897, syntype; photos: BMNH; 14-17 – *A. (s. l.) talautana* Fulton, 1898, syntype; photos: BMNH; 18-20 – *A. (s. l.) crassiventris* B. Rensch, 1931, holotype; 21-23 – *A. (s. l.) patagiata* van Benthem Jutting, 1958 [scale bars 1 mm].

Plate 31

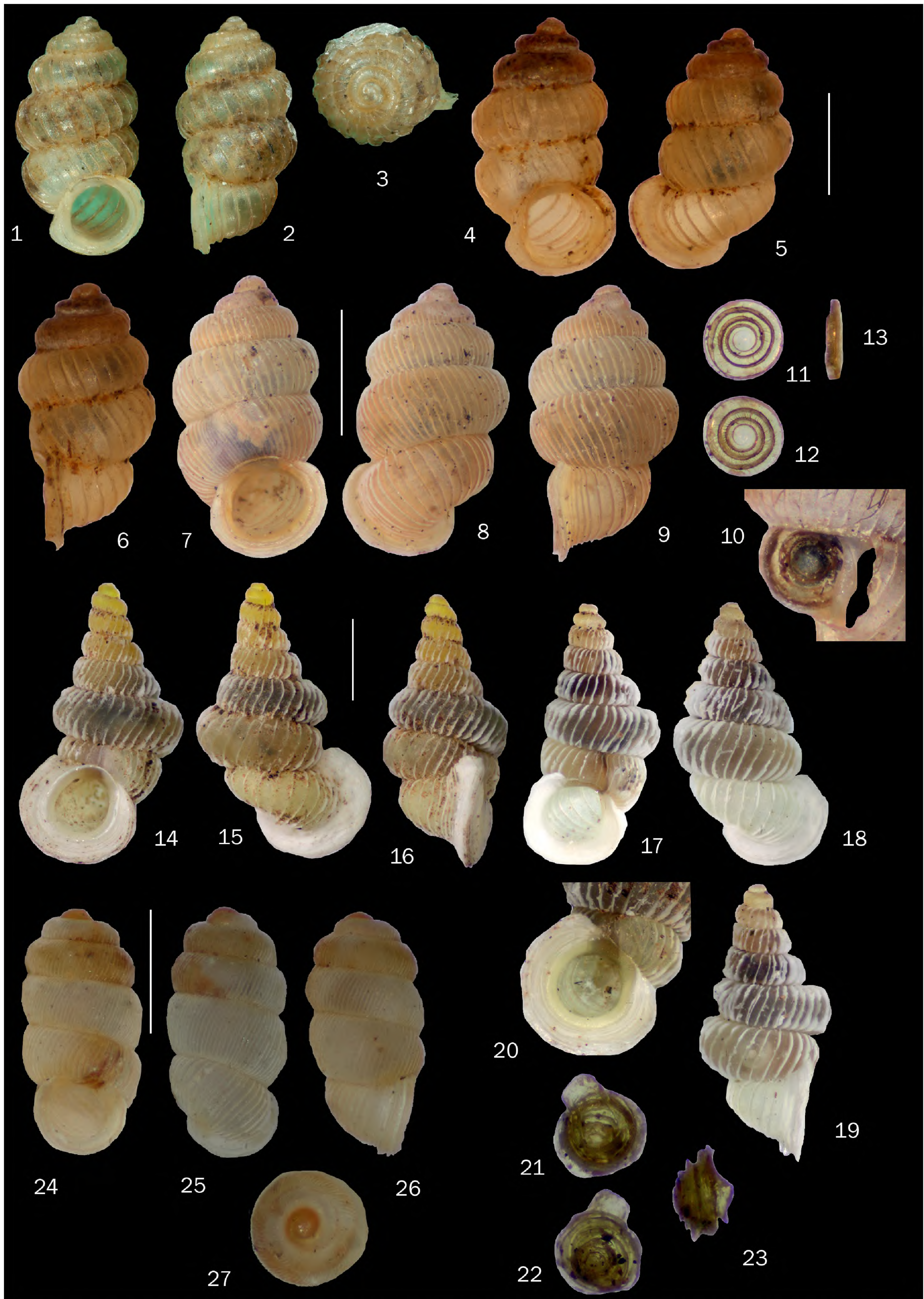
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-20. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-6 – *Palaina* (s. l.) *adelpha* Soós, 1911, paratype in apertural, abapertural, and lateral view and operculum, outer (4), inner surface (5), and lateral view (6); 7-12 – *P.* (s. l.) *albrechti* sp. nov., paratype; 13-15 – *P.* (s. l.) *aerari* (Dell, 1955), holotype (also consider Plate 40 figs 14-16); photos: MONZ; 16-20 – *P.* (s. l.) *ascendens* (Martens, 1864), specimen from Saparua Island (19 – top view, 20 – basal view) [scale bars 1 mm].

Plate 32

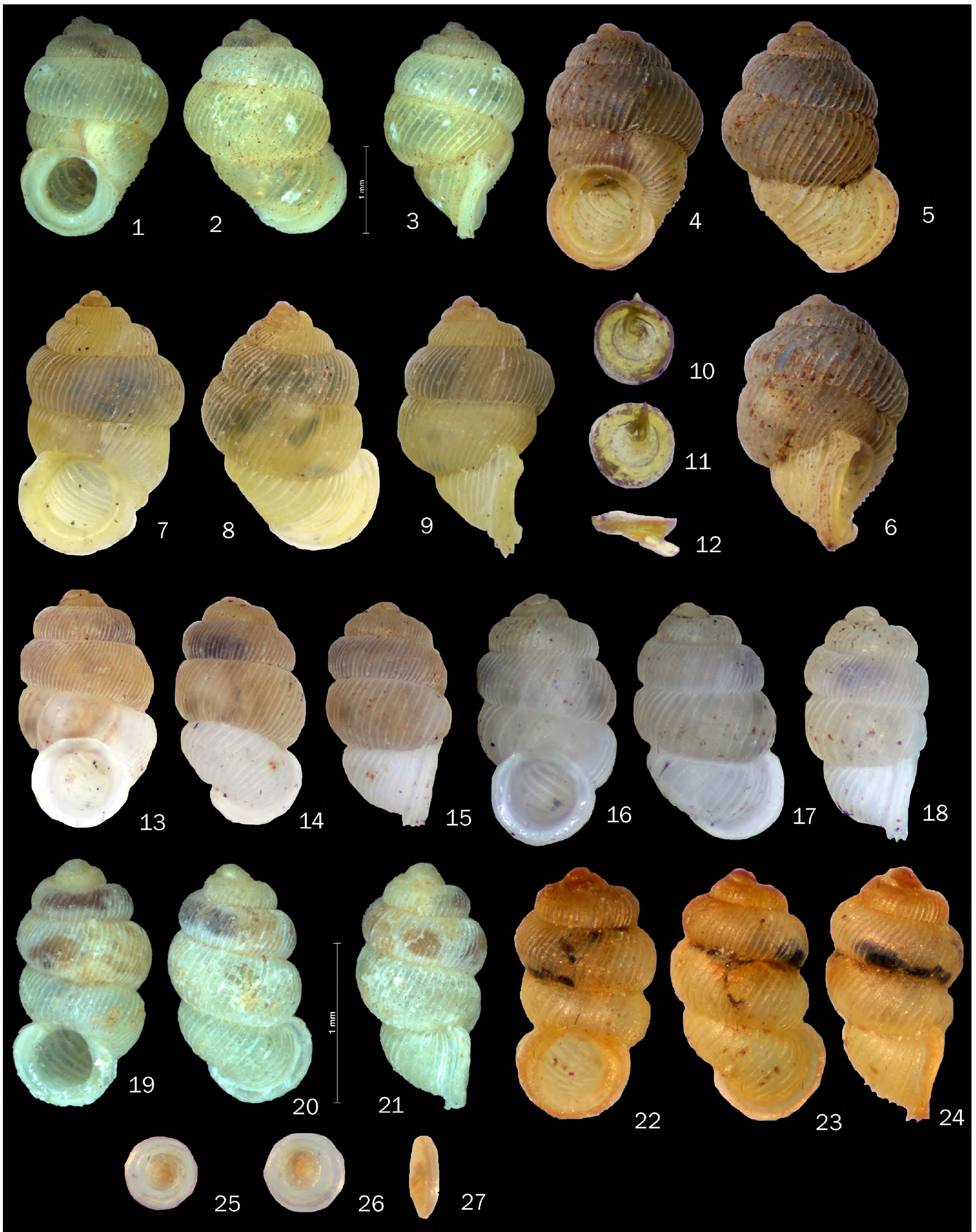
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-27. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-13 – *Palaina* (s. l.) *angulata* O. Boettger, 1891: 1-3 – Lectotype in apertural, abapertural, and lateral view; photos: SMF; 4-6 – Paralectotype; 7-9 & 10 – Specimen from Saparua Island (10 – Columellar plate and position of operculum); 11-13 – Specimen from Soya vill. env. (Ambon Island), operculum, outer (11), inner surface (12), and lateral view (13); 14-23 – *P. (s. l.) attenboroughi* sp. nov., paratypes; 24-27 – *P. (s. l.) beilanensis* Preston, 1913, lectotype (27 – top view) [scale bars 1 mm].

Plate 33

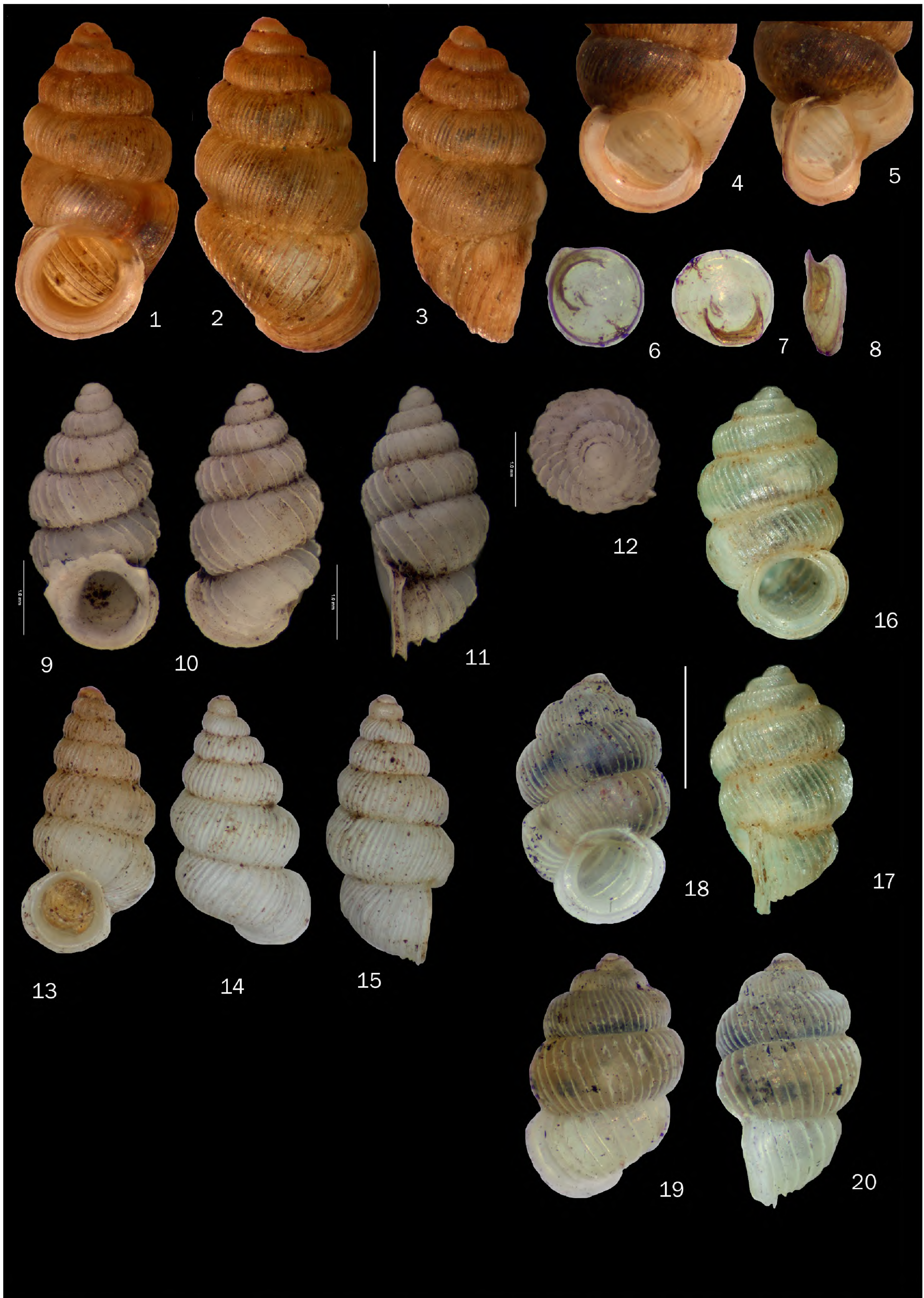
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-27. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-12 – *Palaina* (s. l.) *bicornis* van Benthem Jutting, 1958: 1-3 – Paratype in apertural, abapertural, and lateral view; photos: NMNL; 4-12 – Specimens from River Gam valley (Central Misool); 10-12 – Operculum, outer (10), inner surface (11), and lateral view (12); 13-27 – *P.* (s. l.) *biroi* Soós, 1911: 13-18 & 22-27 – Specimens from various localities in Madang Province (Papua New Guinea); 19-21 – Lectotype; photos: NMNL [scale bars 1 mm].

Plate 34

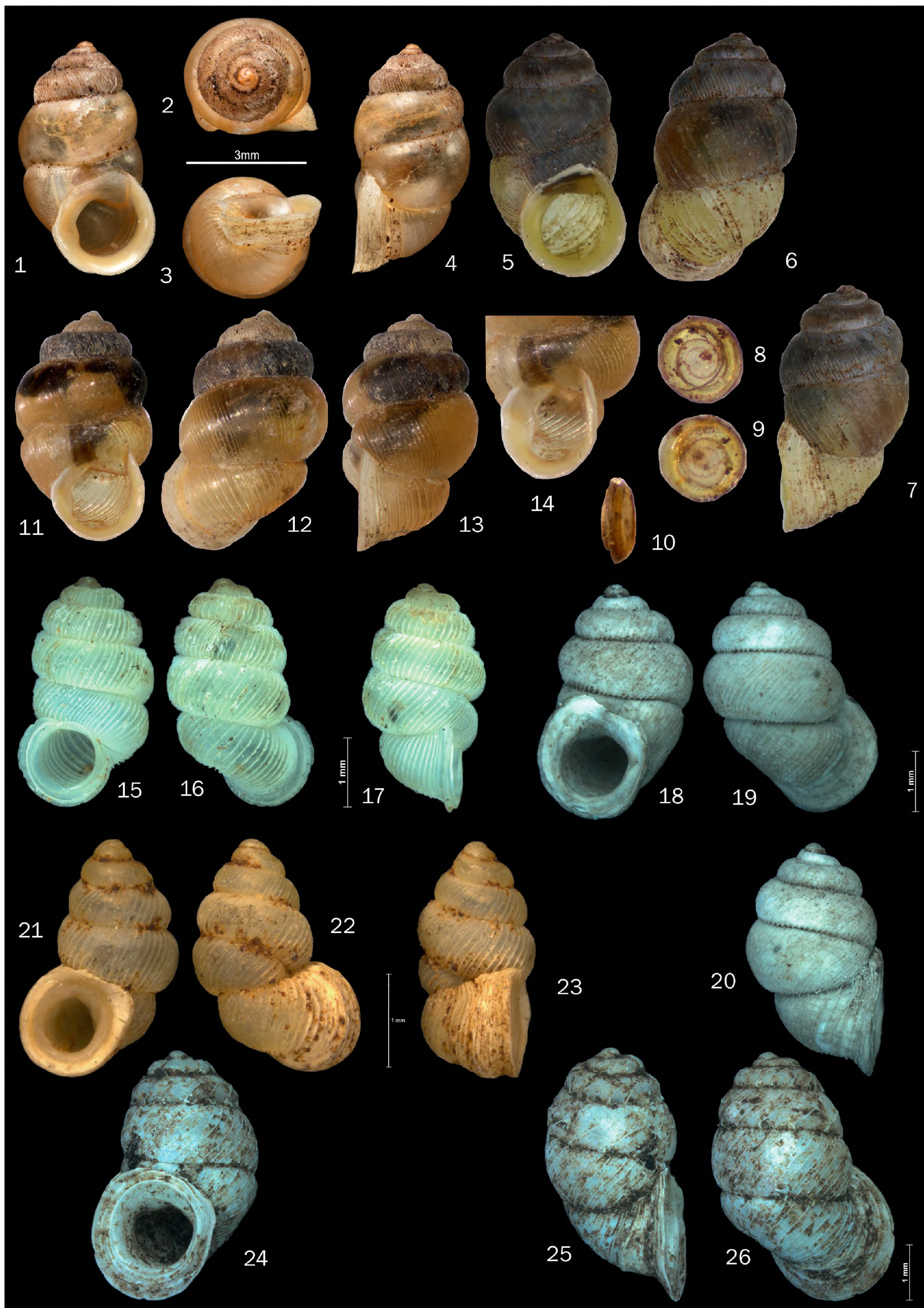
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Figures 1-20. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-8 – *Palaina* (s. l.) *bougainvillei* sp. nov.: 1-3 – Holotype in apertural, abapertural, and lateral view; 4-8 – Paratype; 6-8 – Operculum, outer (6), inner surface (7), and lateral view (8); 9-12 – *P.* (s. l.) *brazieri* (Cox, 1870), specimen from Kira Kira (Makira Island, Solomon Islands) (12 – top view); photos: MCZ; 13-15 – *P.* (s. l.) *bundiana* Wiktor, 1998: 13 – Holotype; 14-15 – Paratype; 16-20 – *P.* (s. l.) *carbavica* O. Boettger, 1891: 16-17 – Lectotype; photos: SMF; 18-20 – Specimen from Horale vill. env., Manusela Ridge (Seram Island) [scale bars 1 mm].

Plate 35

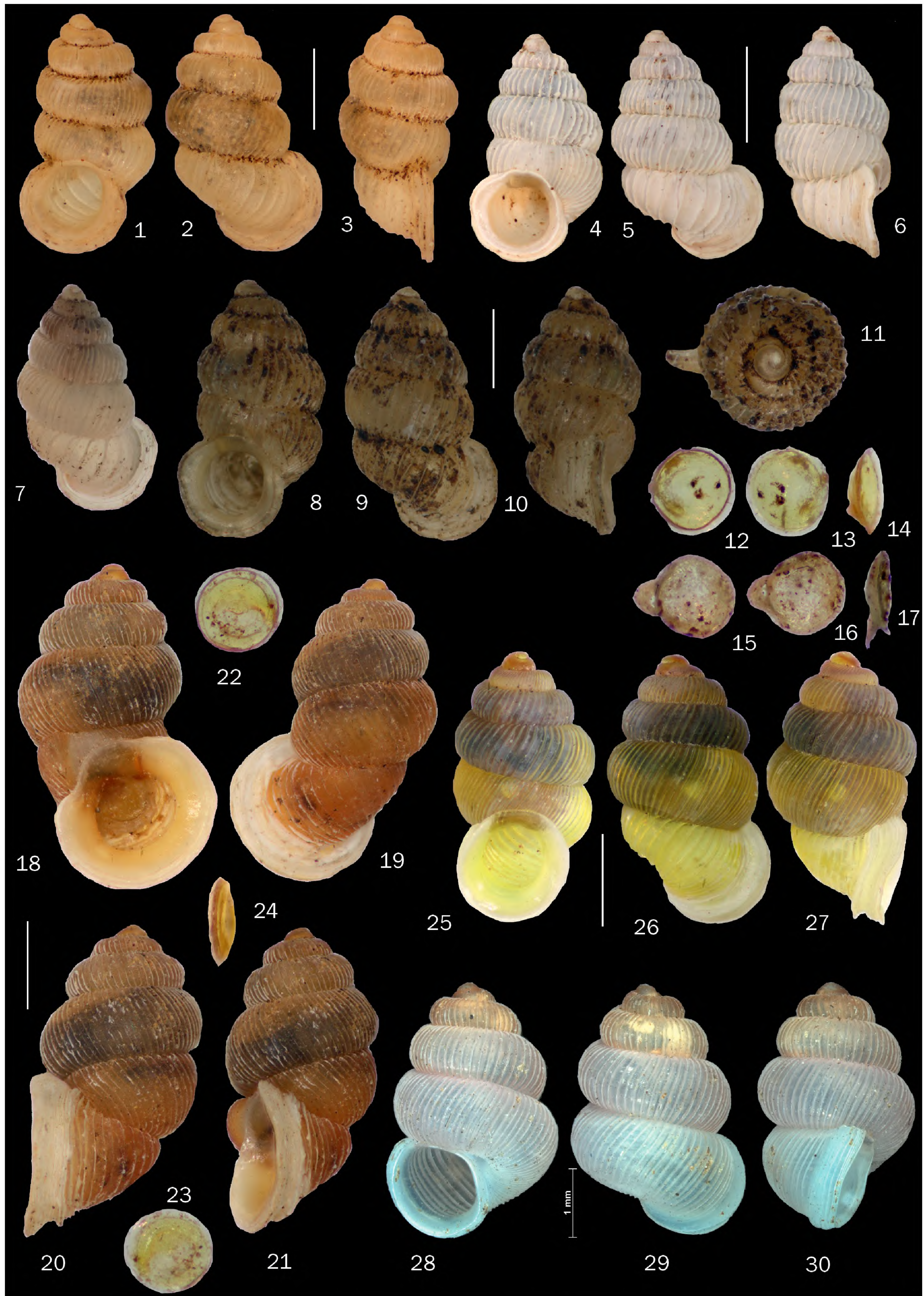
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Figures 1-26. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-13 – *Palaina* (s. l.) *chrysostoma* E.A. Smith, 1897: 1-4 – Syntype in apertural, abapertural, lateral, and top view; photos: BMNH; 5-10 – Specimens from Mount Ranaka (Flores Island) with operculum, outer (8), inner surface (9) and in lateral view (10); 11-14 – Specimen from Tebedo env. (Flores Island); 15-17 – *P.* (s. l.) *citrinella* van Benthem Jutting, 1963, holotype; photos: NMNL; 18-20 – *P.* (s. l.) *consobrina* van Benthem Jutting, 1963, holotype; photos: NMNL; 21-23 – *P.* (s. l.) *clappi* Solem, 1960, holotype; photos: UMMZ; 24-26 – *P.* (s. l.) *cupulifera* van Benthem Jutting, 1963, holotype; photos: NMNL [scale bars 1 mm, figs 1-4 scale bar 3 mm].

Plate 36

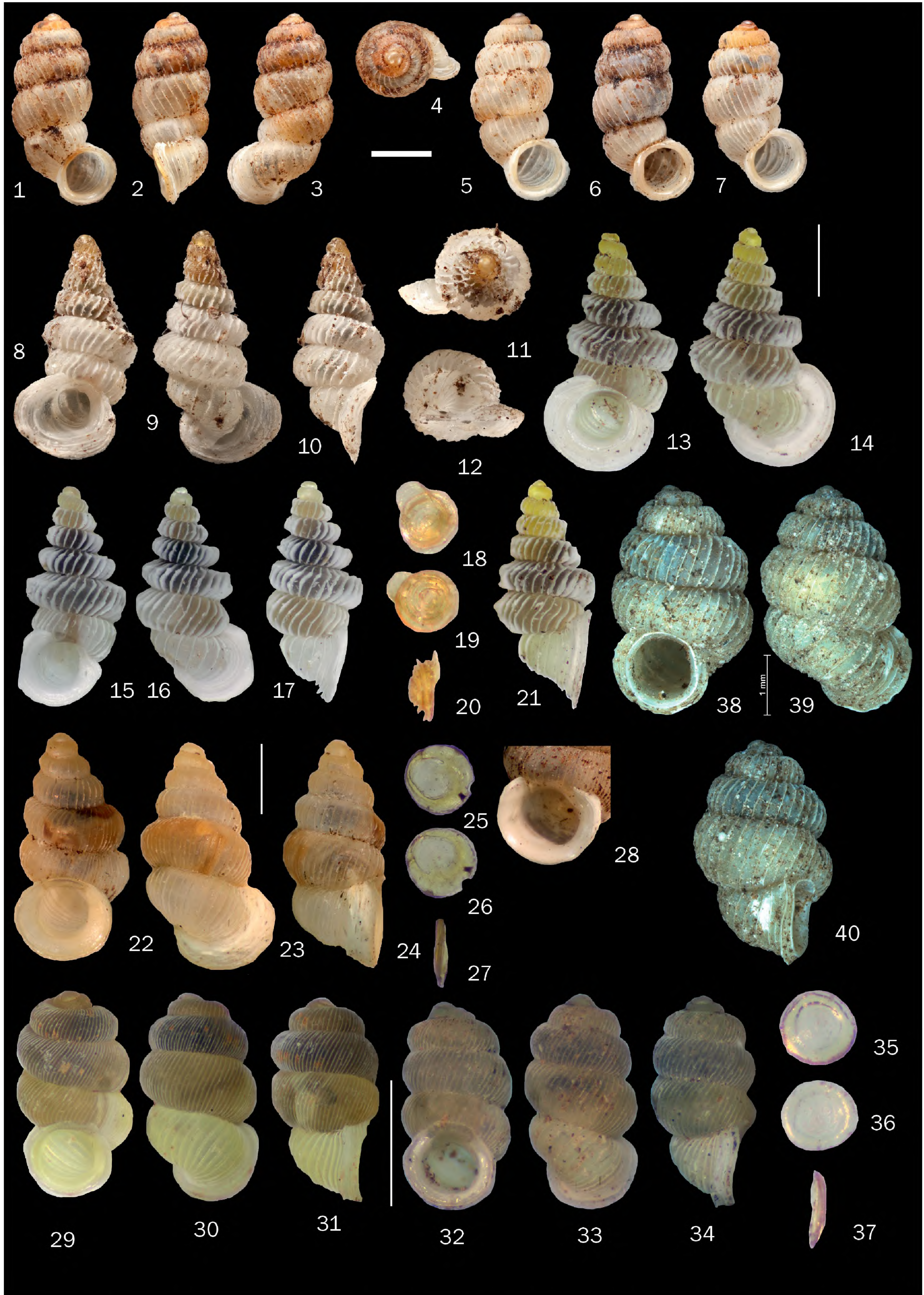
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-30. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-17 – *Palaina* (s. l.) *commixta* I. Rensch, 1937: 1-3 – Holotype in apertural, abapertural, and lateral view; 4-7 & 12-17 – Specimens from Galowe vill. env. (New Britain); 12-17 – Operculi, outer (12 & 15), inner surface (13 & 16), and lateral view (14 & 17); 8-11 – Holotype *P. commixta jacquinoti* I. Rensch, 1937 (11 – Top view); 18-24 – *P. (s. l.) dianctoides* sp. nov., holotype (consider strong bulb particularly visible on Fig. 21); 25-27 – *P. (s. l.) doberai* sp. nov., holotype; 28-30 – *P. (s. l.) erythropeplos* van Benthem Jutting, 1958, holotype; photos: NMNL [scale bars 1 mm].

Plate 37

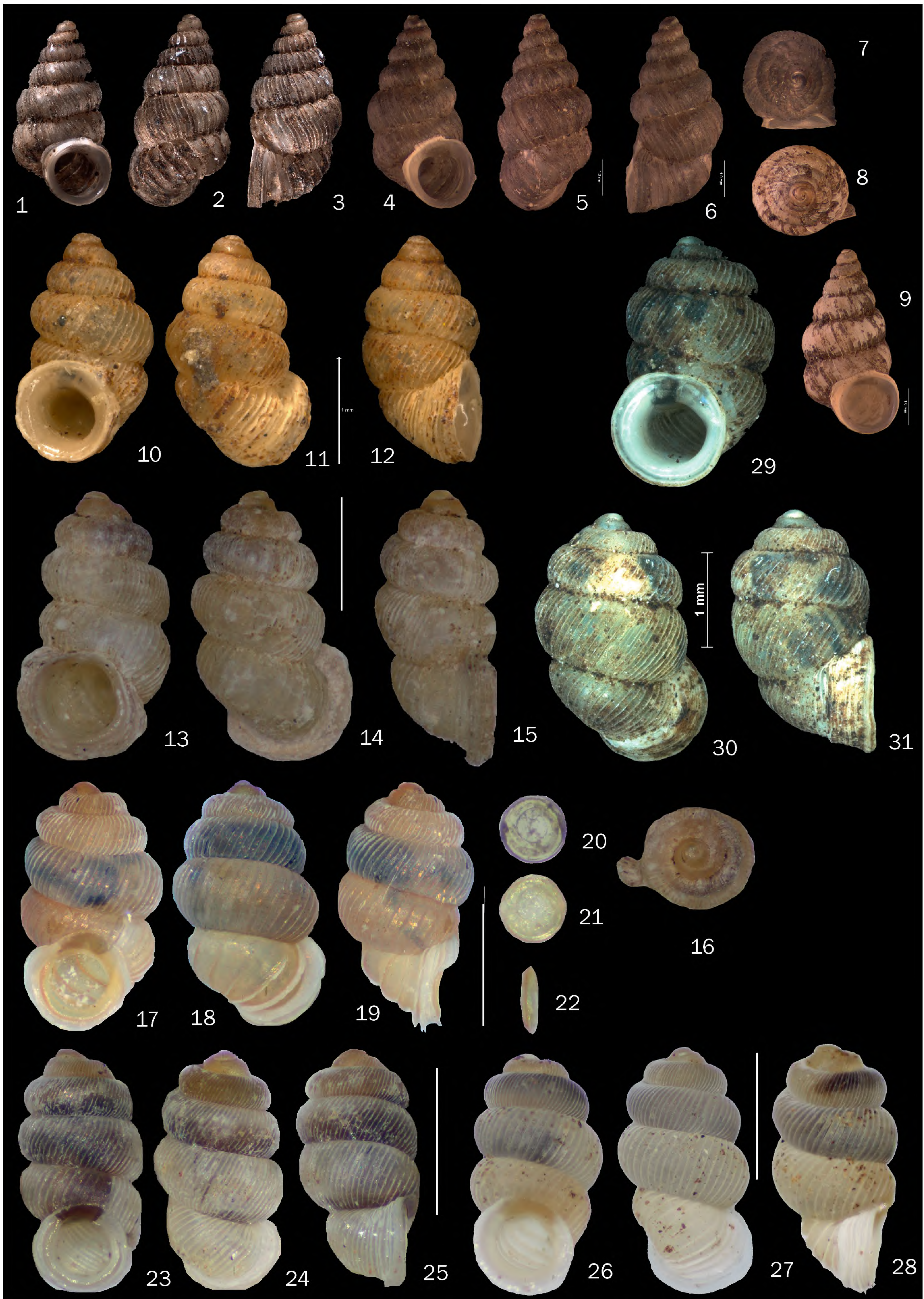
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-40. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-7 – *Palaina* (s. l.) *diepenheimi* (Preston, 191): 1-4 – Lectotype in apertural, abapertural, lateral, and top view; 5-7 – Paralectotypes; photos: BMNH; 8-21 – *P.* (s. l.) *dohertyi* E.A. Smith, 1897: 8-12 – Lectotype (12 – Basal view); photos: BMNH; 13-21 – Specimens from River Sakarteman valley (Onin Peninsula, Indonesian New Guinea), with operculum, outer (18), inner surface (19), and lateral view (20); 22-28 – *P.* (s. l.) *extrema* sp. nov., holotype; 29-37 – *P.* (s. l.) *flavocylindrica* sp. nov., paratypes from Lake Kamakawalar env. (Indonesian New Guinea); 38-40 – *P.* (s. l.) *glabella* van Benthem Jutting, 1963, holotype; photos: NMNL [scale bars 1 mm].

Plate 38

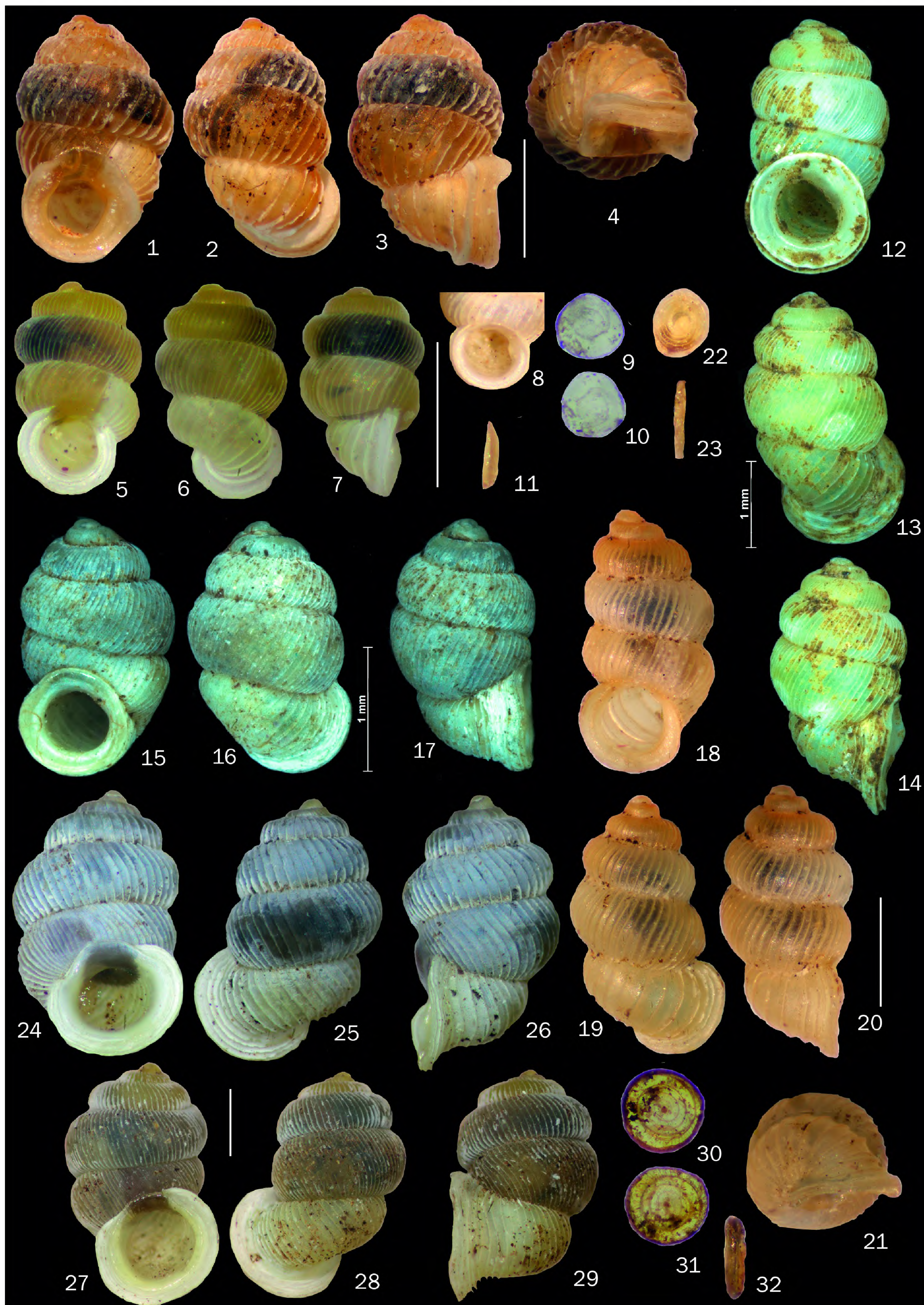
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-31. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-9 – *Palaina* (s. l.) *gardneri* Dell, 1955: 1-3 – Holotype in apertural, abapertural, and lateral view; photos: MONZ; 4-7 – Holotype *P. delli* Clench, 1965 (7 – Top view); photos: MCZ; 8-9 – Paratype *P. delli*; 10-12 – *P.* (s. l.) *floridensis* Solem, 1960, holotype; photos: UMMZ; 13-16 – *P.* (s. l.) *granulum* I. et B. Rensch, 1929, lectotype; 17-22 – *P.* (s. l.) *hartmanni* sp. nov., paratype with operculum, outer (20), inner surface (21), and lateral view (22); 23-25 – *P.* (s. l.) *iha* sp. nov., paratype; 26-28 – *P.* (s. l.) *insulana* sp. nov., paratype; 29-31 – *P.* (s. l.) *inconspicua* van Benthem Jutting, 1963, holotype; photos: NMNL [scale bars 1 mm].

Plate 39

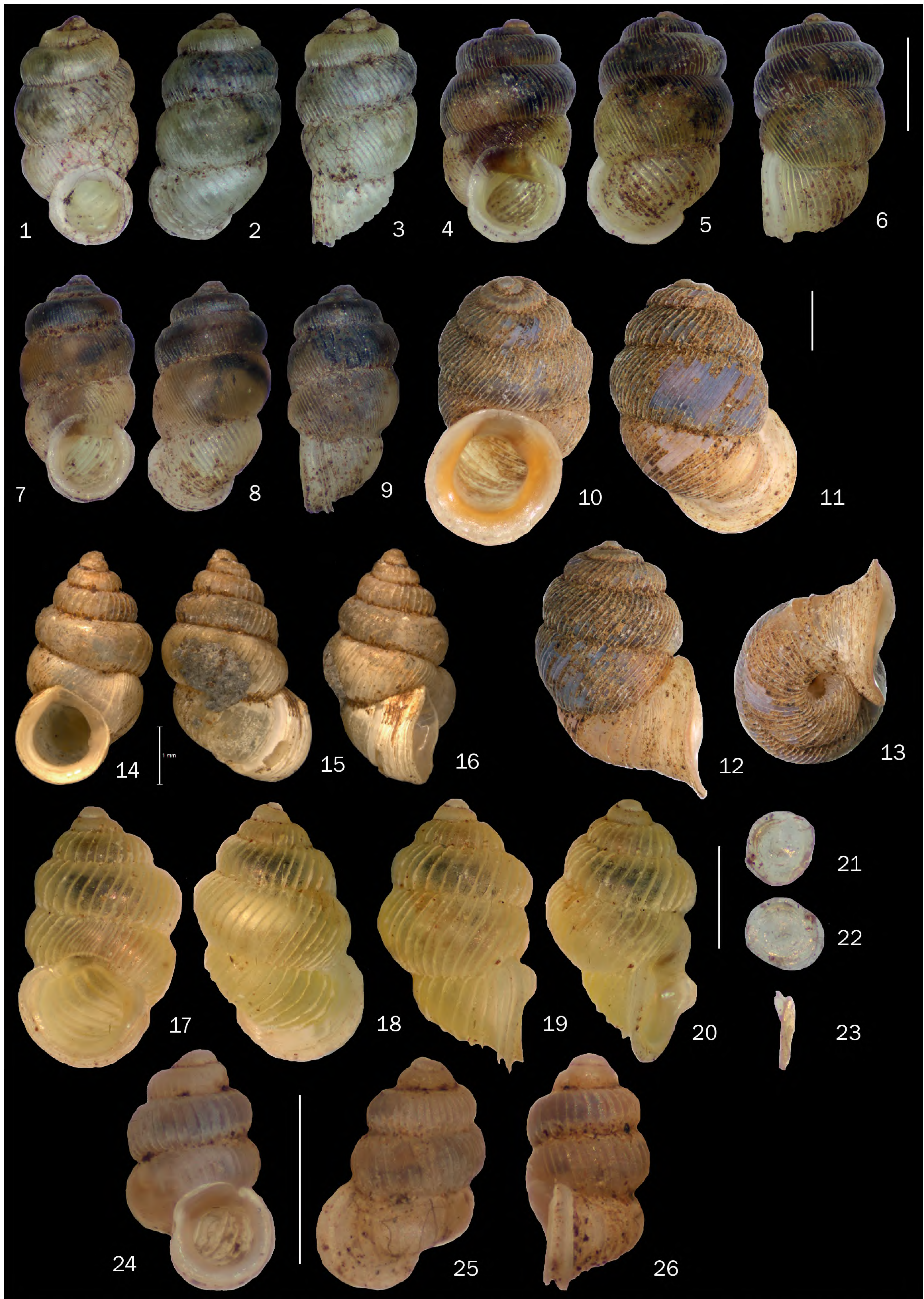
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Figures 1-32. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-4 – *Palaina* (s. l.) *laszloi* sp. nov., holotype in apertural, abapertural, lateral, and basal view; 5-11 – *P.* (s. l.) *lengguru* sp. nov., paratype with with operculum, outer (9), inner surface (10), and lateral view (11); 12-14 – *P.* (s. l.) *leptotoreutos* van Benthem Jutting, 1958, holotype; photos: NMNL; 15-17 – *P.* (s. l.) *liliputana* van Benthem Jutting, 1963, holotype; photos: NMNL; 18-23 – *P.* (s. l.) *louisade* sp. nov., holotype (21 – Basal view); 24-32 – *P.* (s. l.) *mairasi* sp. nov.: 24-26 & 30-32 – Paratype from Lobo vill. (Indonesian New Guinea); 27-29 – Paratype from Lake Kamakawalar env. (Indonesian New Guinea) [scale bars 1 mm].

Plate 40

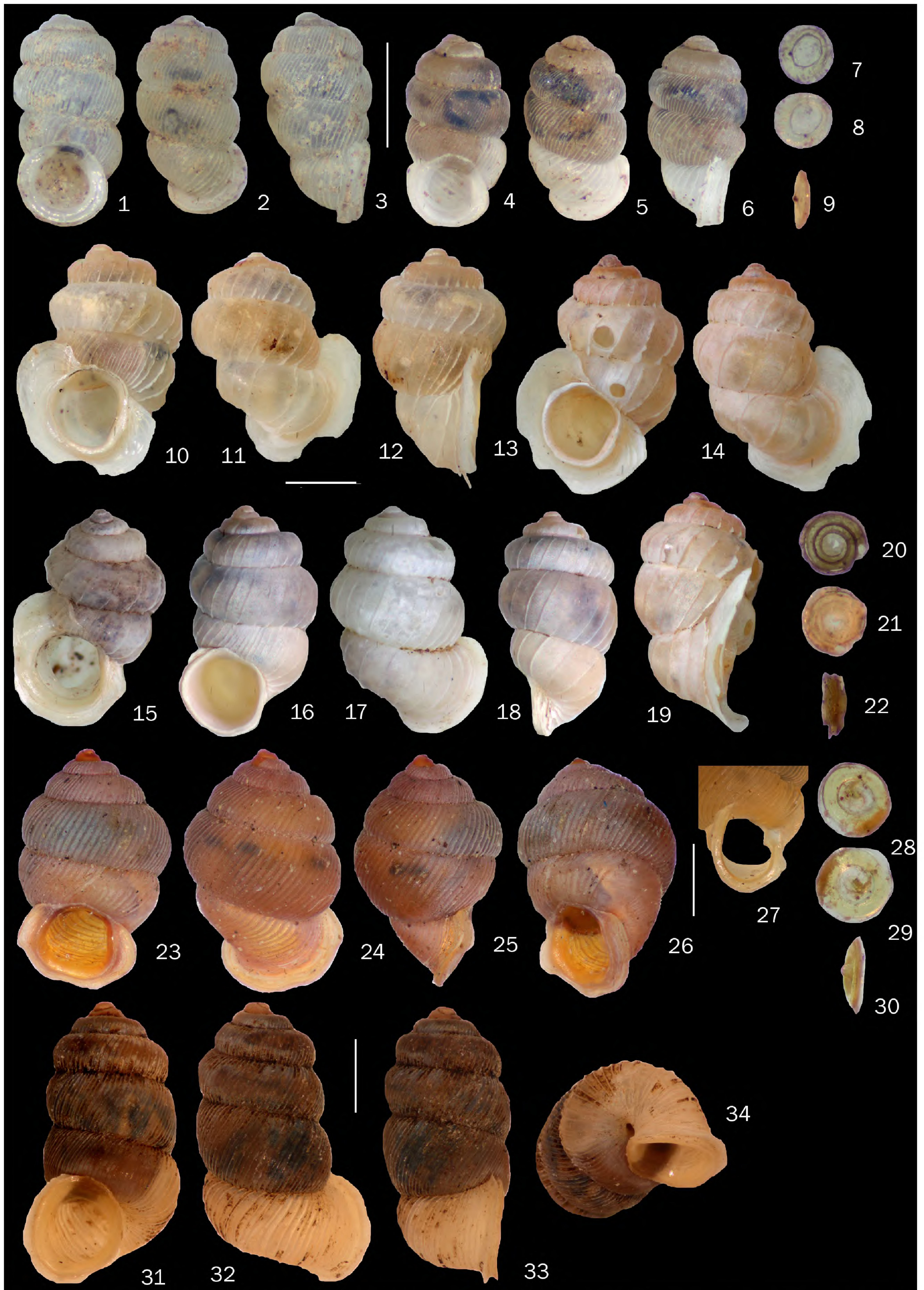
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-26. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-9 – *Palaina* (s. l.) *manggaraica* (B. Rensch, 1931): 1-3 – Holotype in apertural, abapertural, and lateral view; 4-9 – Specimens from Mount Ranaka (Flores Island); 10-13 – *P. (s. l.) megalostoma* sp. nov., holotype (13 – Basal view); 14-16 – *P. (s. l.) aerari* (Dell, 1955) - holotype *P. (s. l.) megamorphia* Solem, 1960; photos: UMMZ; 17-20 – *P. (s. l.) mengen* sp. nov.: 17-20 – Holotype; 21-23 – Paratype, operculum, outer (21), inner surface (22) and lateral view (23); 24-26 – *P. (s. l.) minutula* sp. nov., holotype [scale bars 1 mm].

Plate 41

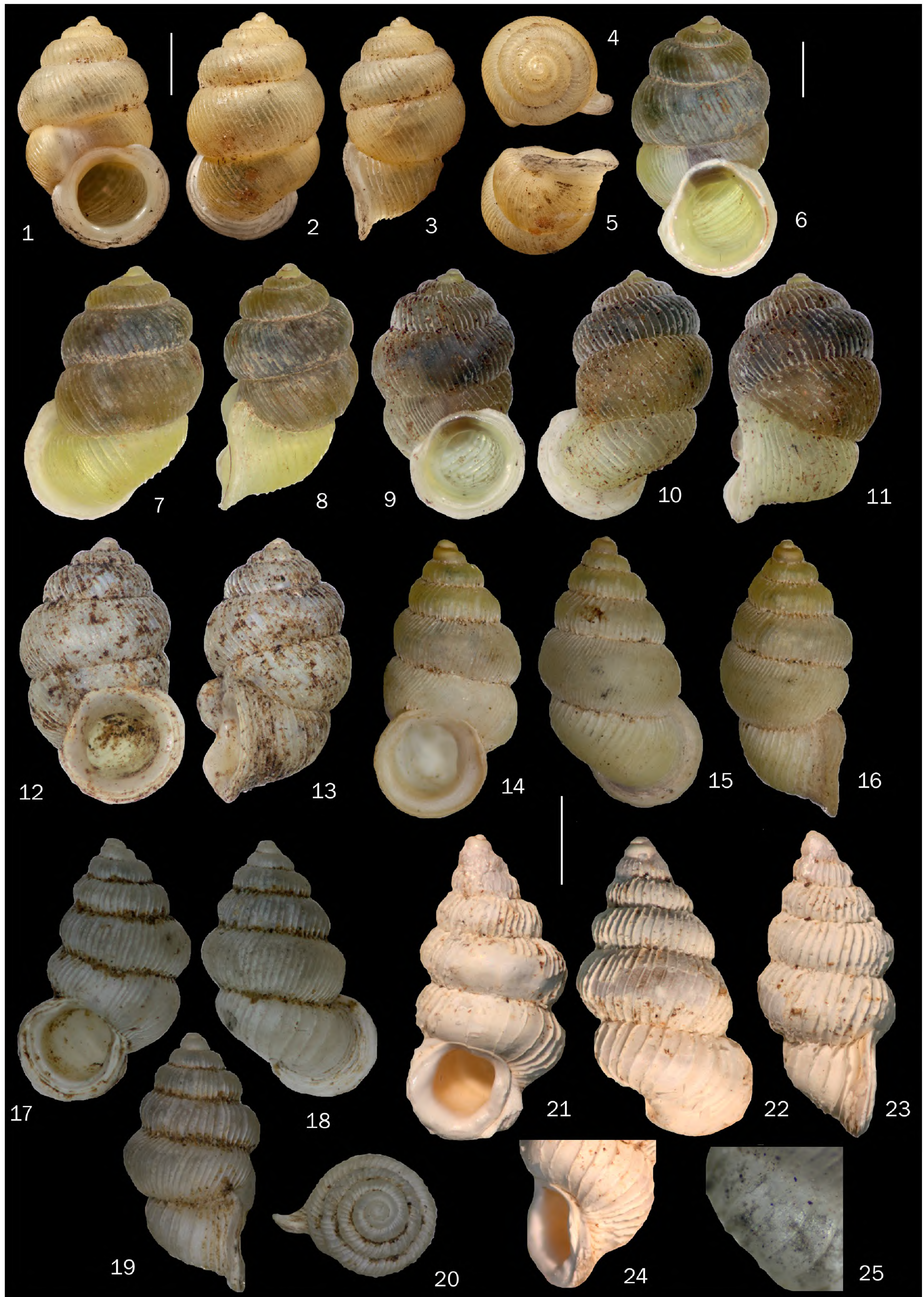
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Figures 1-34. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-9 – *Palaina* (s. l.) *minuscularia* sp. nov., paratypes from Central Misool in apertural, abapertural, and lateral view and operculum, outer (7), inner surface (8) and in lateral view (9); 10-22 – *P.* (s. l.) *mirifica* sp. nov., paratypes; 23-30 – *P.* (s. l.) *misoolensis* sp. nov.: 23-26 – Holotype; 27-30 – Paratype (27 – Aperture); 31-34 – *P.* (s. l.) *mutis* sp. nov., paratype (34 – Basal view) [scale bars 1 mm].

Plate 42

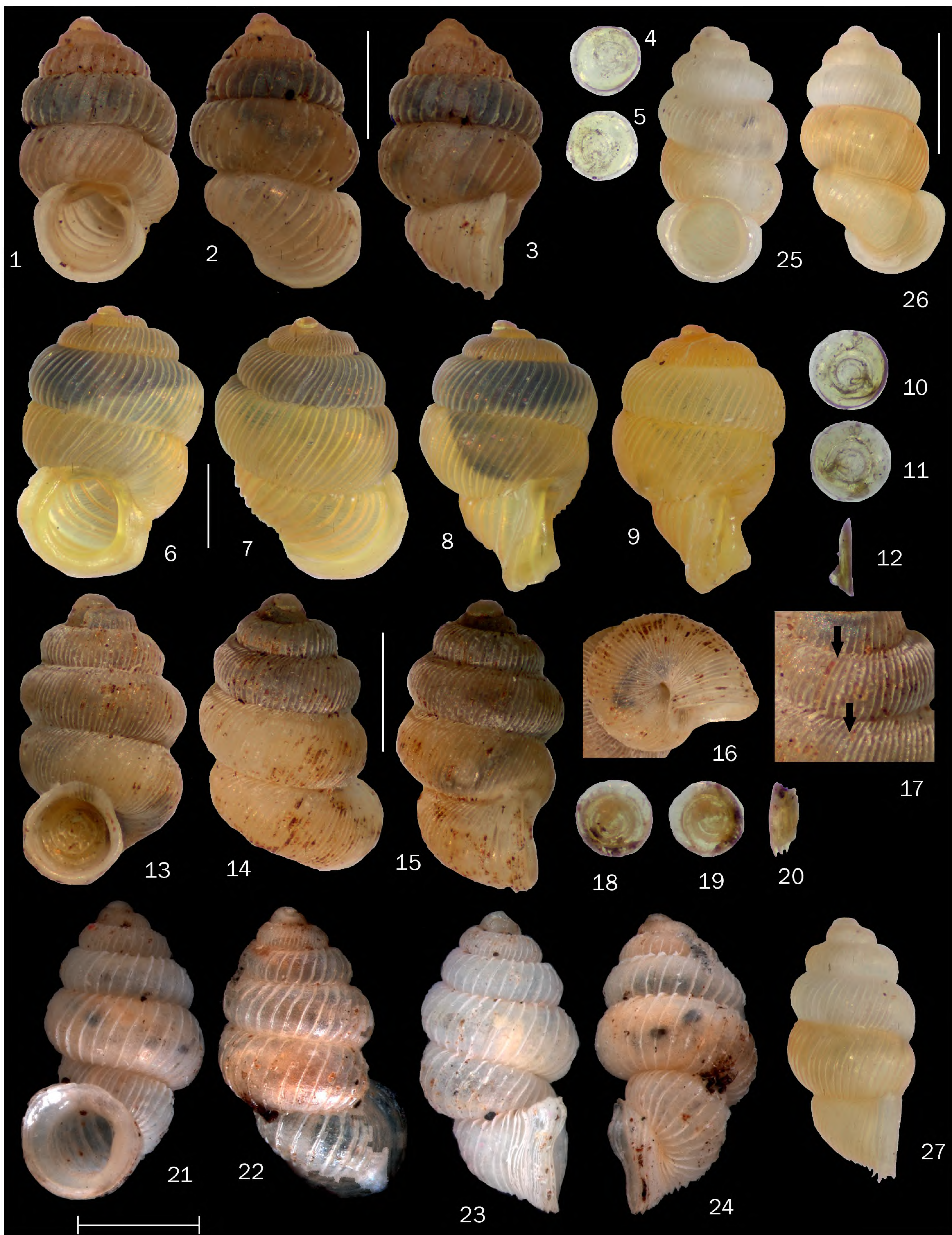
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-25. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-13 – *Palaina* (s. l.) *novoguineensis* E.A. Smith, 1897: 1-5 – Lectotype in apertural, abapertural, lateral, top, and basal view; photos: BMNH; 6-8 – Specimen from Fak Fak env. (Onin Peninsula, Indonesian New Guinea); 9-11 – Specimen from Lilinta vill. env. (Misool Island); 12-13 – Specimen from Kaimana env. (Indonesian New Guinea); 14-25 – *P. (s. l.) novopommerana* I. et B. Rensch, 1929: 14-16 – Lectotype; 17-20 & 25 – Syntype *P. vexator* I. et B. Rensch, 1929; 21-24 – Specimen from Marmar vill. env. (New Britain) [scale bars 1 mm].

Plate 43

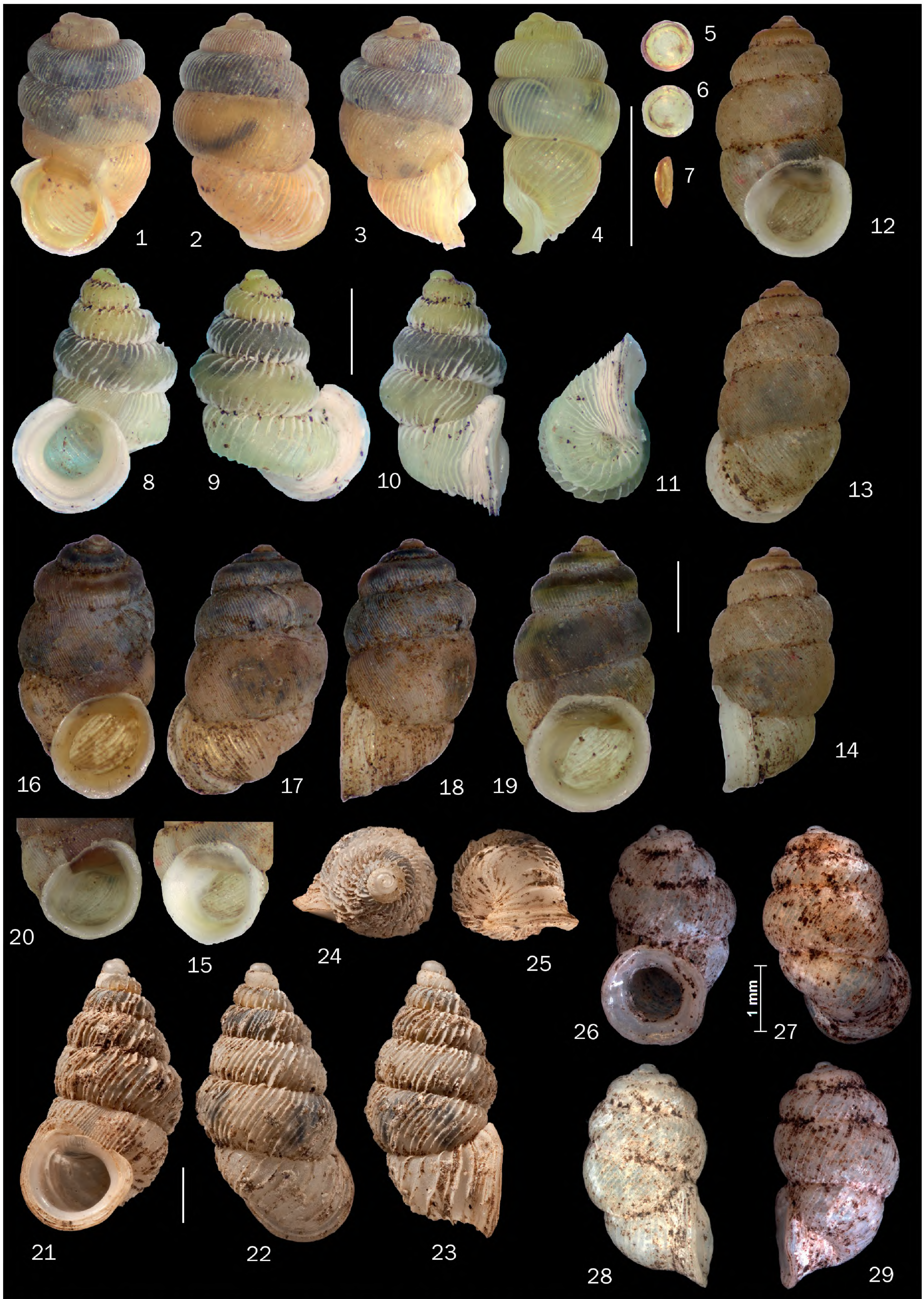
GREKE, K.: Taxonomic review of Diplommatinidae (Caenogastropoda) from Wallacea and the Papuan Region



Figures 1-27. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-5 – *Palaina* (s. l.) *obiensis* sp. nov.: 1-3 – Holotype in apertural, abapertural, and lateral view; 4-5 – Paratype, operculum, outer (4), inner surface (5); 6-12 – *P.* (s. l.) *onin* sp. nov.: 6-9 – Holotype; 10-12 – Paratype (12 – Operculum in lateral view); 13-20 – *P.* (s. l.) *papuamontis* sp. nov., paratype (16 – Basal view, 17 – Consider black arrows pointing to changing ribs height); 21-24 – *P.* (s. l.) *papuanorum* Soós, 1911, lectotype; photos: NMNL; 25-27 – *P.* (s. l.) *yamdena* sp. nov., paratype [scale bars 1 mm].

Plate 44

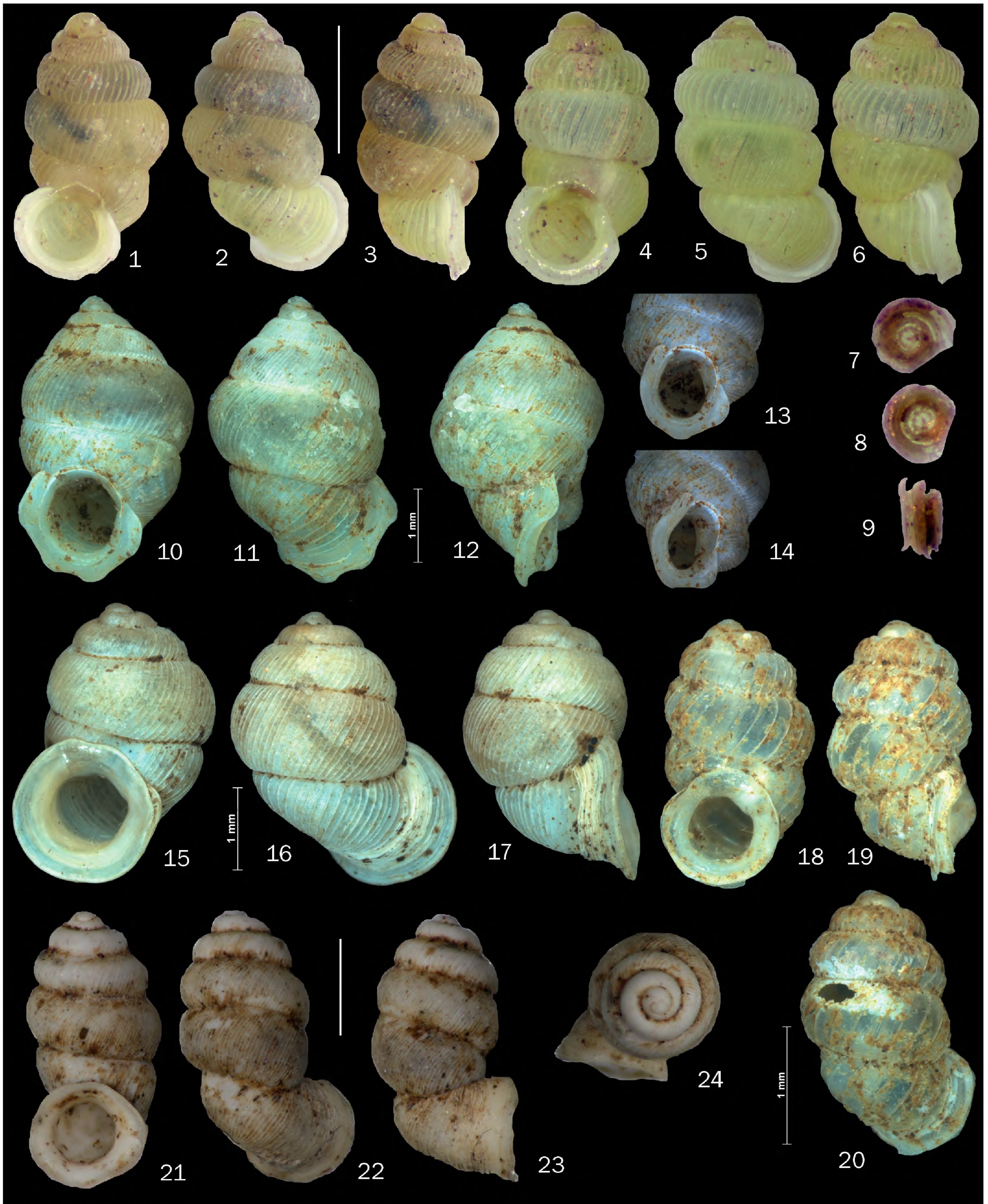
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Figures 1-29. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-7 – *Palaina* (s. l.) *paradisaea* sp. nov., paratype in apertural, abapertural, and lateral view and operculum, outer (5), inner surface (6), and lateral view (7); 8-11 – *P. (s. l.) perspectiva* sp. nov., holotype (11 – Basal view); 12-20 – *P. (s. l.) polystoma* B. Rensch, 1931: 12-15 – Holotype; 16-20 – Specimens from Mount Ranaka (Flores Island); 21-25 – *P. (s. l.) ponsonbyi* Sykes, 1903, paratype (24 – Top view; 25 – Basal view); photos: BMNH; 26-29 – *P. (s. l.) propinqua* van Benthem Jutting, 1963, holotype; photos: NMNL [scale bars 1 mm].

Plate 45

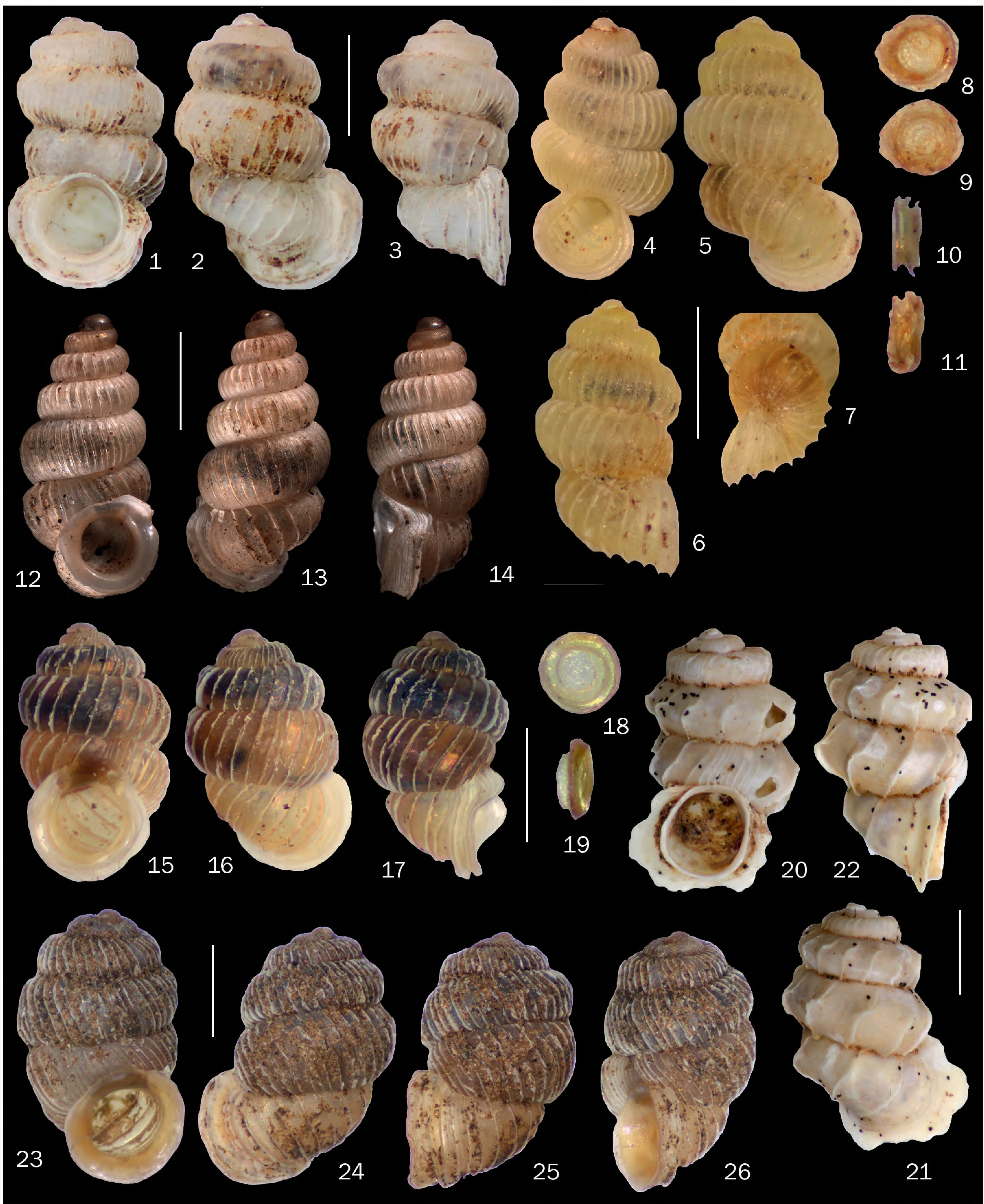
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Figures 1-24. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-9 – *Palaina* (s. l.) *psittricha* sp. nov., paratypes in apertural, abapertural, and lateral view and operculum, outer (7), inner surface (8), and lateral view (9); 10-14 – *P.* (s. l.) *quadricornis* van Benthem Jutting, 1958, holotype; photos: NMNL; 15-17 – *P.* (s. l.) *repandostoma* van Benthem Jutting, 1963, holotype; photos: NMNL; 18-20 – *P.* (s. l.) *scaveola* van Benthem Jutting, 1958, holotype; photos: NMNL; 21-24 – *P.* (s. l.) *schneideri* I. et B. Rensch, 1929, lectotype (24 – Top view) [scale bars 1 mm].

Plate 46

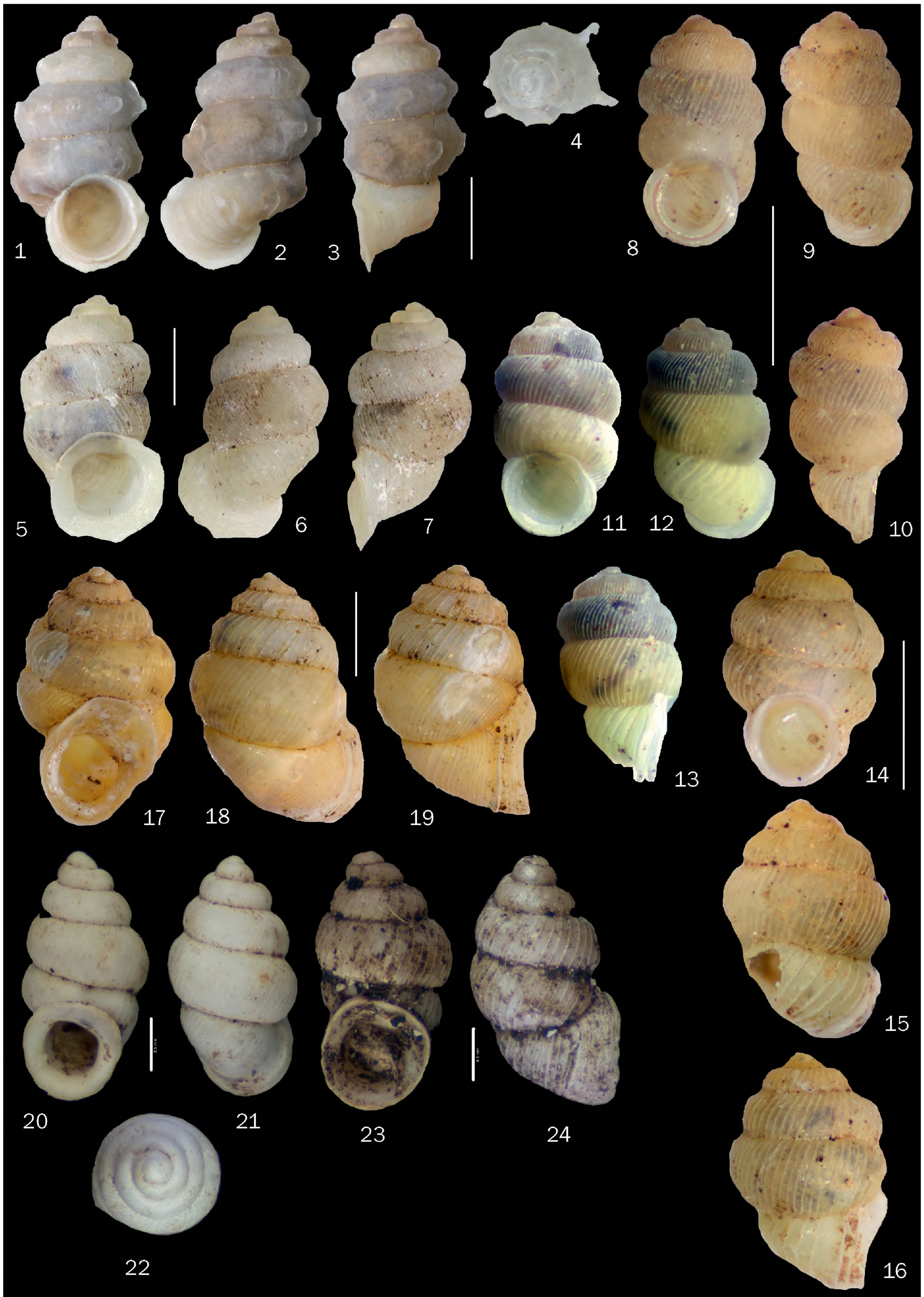
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Figures 1-26. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-3 – *Palaina* (s. l.) *silvicultrix* sp. nov., paratype in apertural, abapertural, and lateral view; 4-11 – *P.* (s. l.) *slapcinskyi* sp. nov.: 4 – Holotype; 5-11 – Paratypes (7 – Basal view) and operculum, outer (8), inner surface (9), and lateral view (10-11); 12-14 – *P.* (s. l.) *solomonensis* (Dell, 1955), holotype; photos: MONZ; 15-19 – *P.* (s. l.) *sparselamellata* sp. nov., holotype; 20-22 – *P.* (s. l.) *tanimbarensis* sp. nov., paratype; 23-26 – *P.* (s. l.) *telnovi* sp. nov., holotype [scale bars 1 mm].

Plate 47

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Figures 1-24. Papuan Diplommatinidae. *Palaina* O. Semper, 1865. 1-4 – *Palaina* (s. l.) *thomasrinteleni* sp. nov., paratypes in apertural, abapertural, and lateral view and juvenile specimen in top view; 5-7 – *P.* (s. l.) *vermeuleni* sp. nov., holotype; 8-13 – *P.* (s. l.) *waigeo* sp. nov.: 8-10 – Paratype from 4.5 km SW Waisai (Waigeo); 11-13 – Paratype from 3 km W Waisai (Waigeo); 14-16 – *P.* (s. l.) *imperfecta* sp. nov., holotype; 17-19 – *P.* (s. l.) *wawiyai* sp. nov., holotype; 20-24 – *P.* (s. l.) *wisemani* (Cox, 1870): 20-22 – Specimen from Makira (Solomon Islands) (22 – Top view); 23-24 – Specimen from Owaraha (Solomon Islands); photos: MCZ [scale bars 1 mm, figs 20-24 scale bars 0.5 mm].